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Founded 1871

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- A Major Scottish Sand Dune System
By Mr Colin R. McLeod 5-127

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BARRY BUDDON
-A MAJOR SCOTTISH SAND DUNE SYSTEM

By COLIN R. McLEOD
Dundee

> "*We have a sea near us, the Firth of Tay, along which run many miles of sweet sward and most fantastical miniatures of hills and valleys...*"
> - Thomas Erskine of Linlathen, in a letter to Thomas Carlyle, 23 March 1841
> (Hanna, 1877, p.15)

Abstract: The peninsula of Barry Buddon, on the east coast of Scotland, is one of the largest and most important sand dune systems surviving in a near-natural condition in the UK. For more than a century it has served as a dedicated army training ground – a use which ensured its survival, but also limited scope for studies of the area. Barry Buddon has seen many changes over the centuries. The inland portion formerly supported arable agriculture, while much of the seaward portion was mobile bare sand dunes. However, the dunes today are mostly vegetated and immobile. The coastline itself is naturally dynamic, but recent decades have seen the major part of it fixed in position too, by artificial coastal defences. This paper describes the natural history and human history of the area, based primarily on a comprehensive literature review, and attempts to explore some of the ways in which, even in this seemingly near-natural environment, the two subjects have been closely intertwined.

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1. Introduction

Barry Buddon is one of the largest and most important sand dune systems surviving in a near-natural condition in the UK. However, in contrast to other dune areas which have been the subject of numerous published scientific papers and articles, sometimes even entire volumes[1], the literature for Barry Buddon is comparatively sparse, and much of which has been written has remained scattered and relatively unknown in more or less obscure 'grey literature'.

The present account is based primarily on a desk study, principally a comprehensive review of the available literature, supplemented by a number of visits to the area. It has been adapted and expanded from an earlier unpublished version deposited with local libraries and other bodies (McLeod, 2004). The account concentrates on historical aspects, which seem not to have been examined in depth since Warden's work in the 1880s; Woolven (1987) addresses natural history in more detail. However, even in this seemingly near-natural environment, human history and natural history are closely intertwined, just as much as in the more obviously managed landscapes such as woodland or heathland that have tended to be the main focus of environmental historians. As is often the case, the written historical record presents difficulties of interpretation, being incomplete and occasionally contradictory – sources appear at irregular intervals, sometimes decades apart, and were usually intended to serve quite different purposes from those of the modern researcher. The present account should not be regarded as definitive, and there remains much scope for further scientific and historical research, both in the field and from archival sources. One such study has recently been undertaken by MoD Defence Estates' Archaeological Advisor, but was not available at the time of writing.

2. Location

Barry Buddon (or Barry Links) is a triangular foreland on the south-east coast of Angus in east Scotland, on the north shore of the mouth of the Firth of Tay. Two 4.5 km-long sand beaches converge at Buddon Ness at the southern tip of the foreland, with the extensive intertidal sandbanks of Gaa Sands, submerged during most of the tidal cycle, lying to the east of Buddon Ness. The modern landward boundary is usually considered to be the east coast railway line between Monifieth and Carnoustie, together with the Buddon and Barry Burns which delimit the western and eastern boundaries respectively. Historically, before the land to the north of the railway was developed for agriculture and golf courses, the inland limit of the Links would have been the raised beach cliff at Barry. Today, Barry Buddon covers a total area of almost 10.5 km^2; it is the only extensive intact survivor of the sand dunes which once backed over 20 km of the Angus coast from Arbroath to Broughty Ferry.

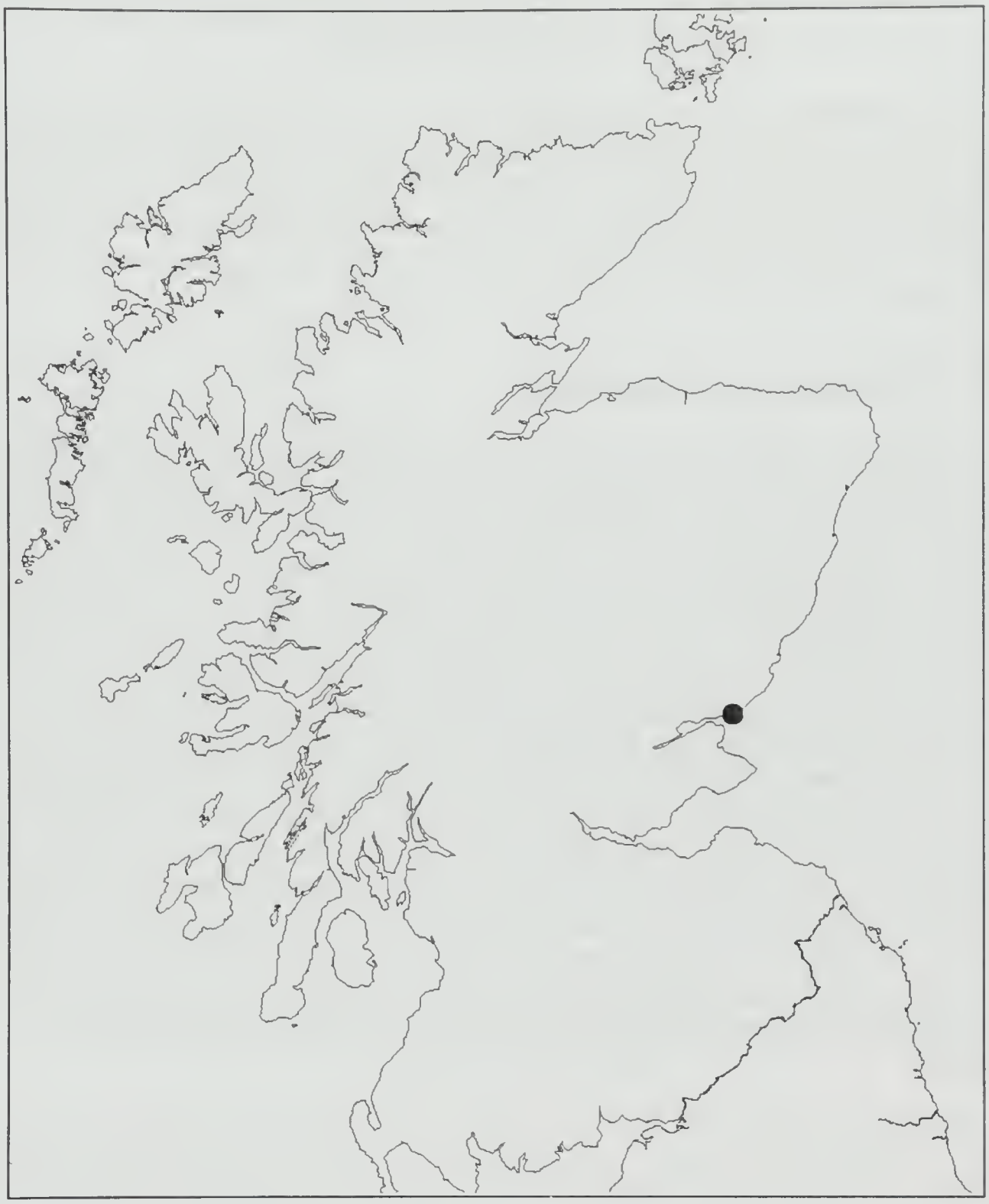

Figure 1

Location map showing Barry Buddon

Most of the peninsula lies in the parish of Barry, with the western portion being in Monifieth parish and a small corner of Monikie parish.

The present account describes primarily the area to the south of the railway within Ministry of Defence ownership, which includes part of Monifieth Links to the west of the Buddon Burn. However, coverage is not totally restricted to this area, and for this reason the more all-encompassing name Barry Buddon has been used, rather than Barry Links, which is usually taken to refer to only the surviving area of duneland.

3. Geography and Topography

The name 'Buddon', like Boddin Point farther north on the Angus coast, Buddo Ness in Fife, Buddie (or Beddie) Myre on Earlshall Muir just across the Tay, and Boddam, Aberdeenshire and Shetland, suggests 'bottom', and implies a low-lying area[2]. Some 18th and 19th century maps (for example, Moll, 1745; Headrick, 1813; Blackadder, 1826) give the name 'Button Ness'; an earlier 16th century navigator made no distinction between the Ness and the Gaa Sands, and called it 'Inch-Ga' or 'Inche-ga' (Gordon, n.d. a,b). Much of Barry Buddon is indeed level and low-lying, mostly no more than 6 metres above sea level (ASL). The crests of the dunes behind the eastern shore stand at an average of 7.5 m above mean sea level, and those behind the western shore average 10.5 m (Boalch and McManus, 1989). The Sandy Downs, or Gaa Sandhill, in the south-eastern part of the peninsula, is the highest point, reaching 29 m. Farther north, Barry Ridge is the most extensive 'upland region', reaching 19 m; it is almost the only part of the peninsula apart from the hindshore dunes to exceed 10 m. In the west, near Buddon Camp, the highest point is St Helena, at 13 m. Other 'summits' have been given names by the army, sometimes commemorating famous battles: The Plateau, The Pinnacle, Spion Kop, Hog's Back, Green Braes, North Hill, Lighthouse Bluff. None of these much exceeds 10 m in height.

The largely level nature of the peninsula, and its use for army training, has resulted in each higher point being carefully named. There were place-names before the coming of the army, and Ordnance Survey mapping, though they may have changed down the years; earlier recorded names for prominent sandhills included Johnny Taylor's Hillock, Geordie's Hillocks (Blackadder, 1826) and March Hillock (Horne, 1842), while the plains between the hills also had names: the Sand Moss, South Hanslet, The Gaa (not to be confused with the Gaa Hill or Gaa Sands!) and Cutty Glen (which later became known as Barry Glen or Happy Valley).

Blackadder (1826) levelled the 'Gaa Hill' (the highest part of the Sandy Downs) at 120 feet [36.5 m] ASL, and other hills at 20-47 feet [6-14 m] ASL. By 1866 its summit was given as 32 m (Vidalin, 1871). It would seem that the Sandy Downs are

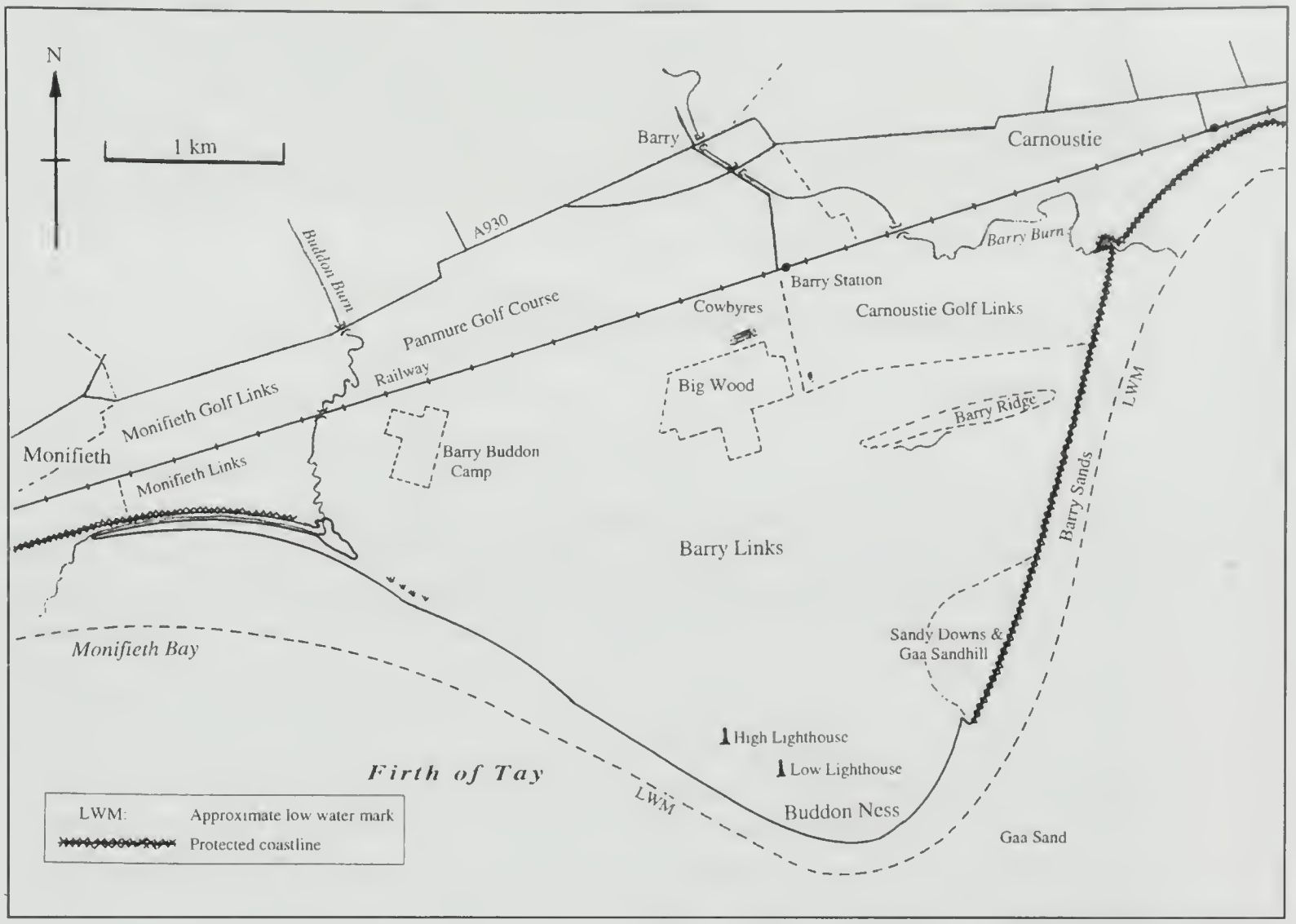

Figure 2

Sketch map of Barry Buddon,
showing some of the principal features mentioned in the text.
Drawn by the author.

significantly reduced from their former height, but that the average size of the other dunes has remained fairly constant over nearly two centuries. High wind speeds mean that dunes in Scotland seldom exceed 25 m height (SNH, 2000). Although larger dunes can occur on the east coast, for example reaching 57 m at Forvie, Aberdeenshire, these have generally accumulated over a pre-existing raised topography (Ritchie, 1972, 1992), making the size of the Barry Buddon dunes, which do not overlie ridges or plateaux, exceptional.

4. Geology, Soils and Geomorphology

Solid geology

The underlying bedrock is Devonian Lower Old Red Sandstone of the Garvock Group, but this does not outcrop anywhere at Barry Buddon, only rising to the surface on the shore from Carnoustie eastwards. A scattering of pebbles occurs in places, but there is no evidence to suggest that there is any extensive shingle platform underlying the sand, such as is present at some other dune sites. All building stone has been imported, and the gabions and rock armour installed along the eastern shore and at Monifieth Links since the 1980s to prevent erosion of the firing ranges and golf course are made with imported basalt, at least some of which was quarried near Collace, in the Sidlaw Hills. The 'shingle' that still mars parts of Monifieth Sands to the west is the eroded remains of rubble that was tipped over the dunes until the 1970s. Even the boulders exposed low on the shore south of Monifieth[3] are almost certainly ships' ballast, probably deliberately dumped (as is the case of Lucky Scalp, off Tayport on the opposite shore (McManus, 1999a,b)), although said locally to be ballast from a vessel that foundered there.

Origins

At the end of the last Ice Age, relative sea level was well below present levels – by perhaps as much as 80 m – and the whole of the present St Andrews Bay from Fife Ness to Arbroath was dry land. Around 10,000 years before present (BP), sea level began rising as a result of the rapid melting of the Scandinavian and Laurentide ice sheets. At the time of this post-glacial marine transgression, the whole of the Barry Buddon area was submerged, as evidenced by the raised beach cliff which fringes the coast from Dundee to Arbroath, and which is clearly visible at Barry. This is the '25-foot' raised beach, around 10 m above present sea level, dating from around 6-7,000 years BP; this cliff is the most prominent and extensive of four former shorelines which have been mapped in Angus (Rice, 1962). Subsequent uplift of the land outstripped sea-level rise, until relative sea level stabilised at near its present level, probably around 3,000 years BP. This geological history was early recognised - Chalmers (1803) described Monifieth Parish as "containing nearly 3,710 Scots acres,

of which upwards of 400 are sandy downs, covered with bent, and formerly under water"; Gardiner (1848) wrote "...no doubt, at some remote period, the base of the terrace that bounds [the Sands of Barrie] on the north was washed by the ocean waves". Miller (1845) asserted that local place names corroborated this history (unfortunately without giving any examples). An old local verse[4] goes further, not only recalling the area's geological past, but - perhaps - prophesising the effects of rising sea levels:

"The braes of Fettermore [5]
Have been a good ship shore.

The braes of Fettermore
Again shall be a good ship shore."

It is believed that Barry Buddon originated as a result of glacial deposition over bedrock (Armstrong, Paterson and Browne, 1985), although it may also have been influenced by spit formation at the mouth of the Firth of Tay (Mitchell, 1997).

Drift geology, soils and dunes

Almost all of Barry Buddon is covered with sand. In places, beds of mineral-rich sand occur, derived from mica-schist rocks in the Scottish Highlands - it was once even suggested that these deposits could be of economic importance (Davidson, 1937). These beds probably date from Post-Glacial times, but around three-quarters of the sand now present in the Tay estuary system comes from marine sources (Jenkins *et al.*, 2005). Borehole evidence suggests that beneath the dunes, the gradual fall in relative sea level is indicated by a series of emerged shorelines cut into a thick sequence of marine sands (Buddon Sand) which themselves overlie marine clay (Errol Bed) (Paterson, 1981). This thick layer of clay overlies the sandstone bedrock, and was probably laid down at the time of the '100-foot sea', which left a raised beach cliff visible at Carnoustie (Rice, 1962). Sand is quarried from the old raised beach cliff at Cotside Sand Quarry, Barry, but here it is of fluvio-glacial origin, not from former dunes (Paterson, 1977). Clay is occasionally exposed on the shore, and has in the past been exploited at Monifieth for local building projects; it is probably the same stratum that supported a small brick-making industry at Barry in the early 20th century (Valentine, 1912). Towards Monifieth, a thick layer of buried peat up to "twelve peats deep" at a depth of around 1-2.5 metres was formerly dug for fuel (Miller, 1845), and may mark the site of a former loch or bog, or an older estuarine peat deposit laid down during a period of higher relative sea level[6]. The topsoil, where present, is a thin rather peaty gley in some old dune slacks, and buried peaty layers also occur in places; in wetter areas some clay occurs. Farther inland, richer soil is present in the farmland north of the railway, and at the sites of old steadings

within Barry Buddon itself, but it is always light and sandy, and was once considered ideal for growing carrots.

Bare sand once covered a much larger part of Barry Buddon than it does today. Edward (1678b) recorded that, in the early 17th century, fields above Carnoustie were so deeply smothered by windblown sand, that they passed out of cultivation for more than 50 years, and never regained full fertility. Ochterlony (1682) also wrote "some pleasant and fruitful fields, extending about two miles on the south border of Angus, at the mouth of the frith of Tay, about fifty years ago, were richly covered with grass and corns, but afterwards quite covered with sand, carried on them by a furious west wind. However, by the goodness of God, the grass on the north skirts of the field, is again getting above the sand; and those places, which, not long ago, had nothing but the naked looks of barrenness, are now smiling in the grassy vestments, which they have put on". Reports of such events are supported by Warden (1884), who describes a buried soil surface, suggesting that windblown sand had engulfed an earlier landscape. It is easy to assume that parts of Barry Buddon formerly resembled the Sands of Forvie today, or the Culbin Sands prior to afforestation - both fertile estates that were overwhelmed by sand later in the 17th century (Edlin, 1976)[7]. Douglas (1782), describing the journey from Dundee to Arbroath in 1780, wrote "on our right we see a great many small hills, so completely covered by blowing sand that not a single pile of grass grows on them. The sea-shore is all the way flat and sandy." A century later, Warden (1880, p.175) wrote "The sandy links or downs which extend from Broughty Ferry eastward through Monifieth and Barry, and onward to the Elliot Water, are sterile, producing little but stunted grass or bent, fit abode for rabbits, large numbers of which burrow there". In 1829, amongst other botanical records, William Gardiner described a patch of roses west of the lighthouses as being "like a paradise in the midst of a desert"; significantly, these were rooted on a stratum of clay, not sand. The same author later wrote how a ramble on the Sands of Barrie was "...fraught with all the inconveniences of desert-travelling, as heat, thirst, and fatigue..." (Gardiner, 1832). Against these impressions of a barren "sandy desert", as referred to by Maule (1790-91), however, Headrick (1813) records that in the early 19th century, the links afforded albeit scanty pasture for the same number of grazing sheep as in the 1990s[8]. Even Warden's "large numbers" of Rabbits must have had some sustenance, and Warden (1881, p.100) later goes on to give a lyrical description of the flora of the plain behind the dunes, supporting Gardiner's (1848) appreciation of the botanical value of the Links. Indeed, while Gardiner (1831b) himself referred to the 'Sands of Barrie' as "a sterile desert", they held enough vegetation to be one of his favoured botanical hunting-grounds, "...a rich field for the lover of nature" (Gardiner, 1832). It is clear from Gardiner (1848) that the habitat was more diverse than some earlier authors described: "the surface is in some places flat and covered with pasturage, or marshy; in others, diversified with numerous swelling knolls and ridges, either of bare sand, or clothed with mosses, lichens, and maritime grasses".

When the Monifieth Races took place at Buddon from the 1790s until the 1840s (see 'Sport' below), the horses almost certainly ran on turf rather than sand.

Clearly, by the early 19th century, the whole area cannot have remained entirely bare sand, and if the dunes themselves were largely barren, at least part of the plain behind the dunes supported established vegetation. However, intensive grazing by sheep (and later by Rabbits) possibly contributed to the instability of the dunes. The collecting of material for construction of houses probably also contributed at Barry Buddon, as is recorded at Culbin (Ross, 1992) and elsewhere. The widespread use of turf for building until the second half of the 19th century (see 'Agriculture and Crofting' below) involved the stripping of much of the best pasture, and may have caused the continuing instability of areas that otherwise might have become fixed 'grey dunes'. Marram *Ammophila arenaria* may also have been used for thatching, a factor that is known to have contributed to the instability of dunes in north-western Scotland (Angus and Elliott, 1992), even though the removal of 'bent' from the coast had been prohibited since 1695 by an Act of the Scottish Parliament intended to prevent erosion[9].

Ainslie's (1794) map of Angus warns that "the Gaa or sand hills are perfectly barren, and in high winds it is dangerous to be near them". Even in the late 19th century, Warden (1881, p.100) wrote "The eastern portions of the downs facing the ocean are composed of pure sand, almost without vegetation. Here they rise into hills, some of them having an elevation of nearly one hundred feet [30 m]...in storms the sand composing these little hills is blown to and fro with much force, which frequently changes the appearance and height of the dunes". At about the same time, Dickson and Dickson (2002) described 'the Sandy Hill' as being devoid of vegetation, 90 feet (27 m) high, and covering 100 acres (40 ha). At this time it was described as getting steadily lower and more spread out, and also moving eastwards, having overwhelmed two fishing bothies. Possibly the dune was losing sand as an indirect result of marine erosion at its seaward face, or perhaps it had been destabilised more than usual as a result of artillery practice (see 'Army' below). However, a fall in height of 4.5 m was recorded between Blackadder's (1826) survey and that of Slater and Carver in 1866 (Vidalin, 1871), by which time artillery had been in use at Barry Buddon for only one or two years. Assuming that both surveys levelled the dunes accurately, this suggests that the change may have been a continuation of the natural movement of the dunes that had been underway for centuries. Whatever the reason for the change, the lowering in height could have reduced the influence of wind, making the dune less dynamic.

Today the dunes are almost completely vegetated and stabilised, with the exception of the Sandy Downs, still used by the MoD as a target area, but with a much smaller extent of bare sand than the 40 ha of a century ago. This is a change shared

with dune systems elsewhere in the British Isles and western Europe; few of the many 'wandering' medano dune systems that were recorded as overwhelming settled areas centuries ago are still active today. Changes in human management, climate, and reduced sand supply are all likely to have contributed to this trend (Pye, 2001). It is known that, since records began in 1770, the periods of greatest storminess in Scotland occurred during the 19th century, with the highest gale frequencies being recorded during the decades 1811-1820 and 1870-1900 (Dawson *et al.*, 2001). Frequent, strong winds could have helped to maintain the dunes in a mobile condition. A change to a less extreme wind regime would enable their colonisation by vegetation. A number of the shifting dunes at Barry Buddon were still very active as recently as the 1940s (Dargie, 1998). Others, however, were completely vegetated much earlier – for example the dunes that can be seen under trees in Big Wood and elsewhere. Although the pattern of the dunes is still apparent, their geomorphology is now essentially fossilised, since vegetated dunes cannot be moved by the wind - a state shared with the majority of surviving dune systems today. Their pattern is a relict of a time when the area was largely barren. It cannot be assumed that the dunes will remain fixed forever - they could respond to factors such as climate change, increased wind speeds, extreme weather events, a falling water table or different future management practices by remobilising.

The open exposure of the foreland and the lack of topographical interference with formative prevailing winds from the south-west may explain the regular form, orientation and pattern of the dunes, which have migrated across the foreland from south-west to north-east, leaving a level deflation plain behind them. Over centuries this wind-driven process must have transported vast quantities of sand from inside the Tay estuary to the North Sea, bypassing the headland of Buddon Ness. The few remaining active areas are close to the eastern shoreline, and so have little distance available to travel; Barry Buddon now has no net accretion of sand, and there have been significant losses of dunes due to coastal erosion (Dargie, 1998), while more recent coastal protection measures have cut off any potential sand supply from the beach. If the dunes were to become reactivated in future, they might eventually be lost to the peninsula altogether, leaving only a level plain.

Geomorphological importance

Barry Buddon's earth science interest lies in its geomorphology, for which it is designated as Barry Links Geological Conservation Review site (Hansom, 2003a). Although it contains representative examples of many beach, dune and links landforms, it is the exceptional series of well-developed parabolic dunes that is of outstanding geomorphological significance. Parabolic dunes are relatively rare in Scotland, and are extensively developed in only three areas, all on the east coast: Barry Links; Sands of Forvie; and Morrich More[10]. The parabolic dunes of Barry

Links have a pronounced, elongated V-shaped form, compared to the more U-shaped forms of the other sites (Ritchie, in MacTaggart, 1997). Their average length to width ratio (3.3) is unique in Britain, being most similar to coastal dunes in north Queensland and desert dunes in New Mexico (Robertson-Rintoul, 1990). This hairpin-shape was a characteristic of the links by the 19th century (Dickson and Dickson, 2002). Landsberg (1956) showed that wind regime was a major factor in the orientation of the Barry Buddon dunes.

Wetlands

Barry Buddon has few large areas of permanent open water or freshwater springs, but the northern half in particular has a high water table resulting in, during wet seasons, many marshy areas with standing surface water. Like Tentsmuir across the Tay, Barry Buddon seems to be dryer today than formerly. Edward's (1678a) map of Angus shows a small loch in the northern part of the area, between Barry and Cowbyres; it was sizable enough to be listed along with the other lowland lochs of the county by Ochterlony (1682). Later maps do not show this waterbody, suggesting that it was drained around the early 18th century by ditches which still run eastwards to join the Barry Burn. The main drainage channel may have existed previously as the Lochty ('Loch Tay') Burn, before it was deepened and straightened. The site of this loch is marked today by a level area north of the railway close to Panmure Golf Course, and the place-name 'Lochside'[11]. Fields in this area between Panmure Golf Course and the railway still hold pools of standing water after wet weather. The Barry Burn occasionally bursts its banks, and houses on the floodplain were flooded soon after they were built in the 1970s, necessitating expensive flood defence measures. Earlier residents of Barry knew of this hazard, and older buildings stand on higher ground along the road at the edge of the raised beach.

Dickson and Dickson (2002) described the wetness of Barry Buddon in the late 19th century: "The great part is undrained. The water, unless in a very wet season, collects in several hollows or bogs which are scattered through it…[the dune slacks] are a few hundred yards long, and in winter usually contain a few feet of water". It would seem that this was a normal situation in winter, and that in wet years flooding was even more extensive. Although there are still some marshy areas subject to seasonal flooding, such a depth of water is unknown in the slacks today, even in the wettest years. A 1919 Admiralty chart shows a number of large pools in the north-eastern part of Barry Buddon; the fact that Ordnance Survey maps of similar date do not show such extensive flooding suggests that they were ephemeral 'winter lochs'. However, Dickson and Dickson may have described a situation that persisted for relatively few years, perhaps influenced by short-term climatic factors. It is always dangerous to assume that circumstances at any one point in time are the norm, especially in a naturally dynamic environment such as sand dunes. Other early authors do not

comment on the wetness of the area; on the contrary, such very wet conditions would, after drainage, probably have favoured more extensive cultivation of the Links, and would not be conducive to the highly mobile sand dunes described by many writers, as sand grains move readily only when dry. It is no coincidence that early descriptions of Tentsmuir, in contrast, refer to the wetness of the area, but never mention drifting dunes (Whittington, 1996)[12]. Barclay (1888), describing a botanising visit to Barry Links in August 1886, lamented the absence of wetlands "...marshes we somehow or other had imagined to be numerous, but we found them either uncommonly scarce or uncommonly dry".

Even if the extensive 19th century flooding described by Dickson and Dickson (2002) was exceptional, there is little doubt that the water table today is lower than previously. Brichan (1842) noted how iron-rich 'chalybeate water' appeared whenever "a cut of several feet is made in almost any part of the plain of Barry"; a layer of iron oxide in the soil profile visible in places today indicates a former higher groundwater level. A network of ditches, some of which are deep and still functional, drains much of the northern part of Barry Buddon. Several of these, for example alongside the Lighthouse Road, were widened and deepened by the army as recently as the 1980s, but it is now considered that the level of drainage is incompatible with the site's nature conservation interests, and the practice of controlling water levels is now subject to review (SNH, 2005).

A major drain dating from the 19th century crosses Carnoustie Golf Links, and drains the north-eastern part of the Links. In the south, a drainage pipe which cuts through the dunes between the High Lighthouse and Buddon Camp is the outlet for a ditch, probably dug by the army, which drains a large dune-slack catchment in the centre of the area.

The outflow from these may partly account for the relative dryness of the links today. The recent spread of trees is also likely to lower the water table, as has occurred at Tentsmuir - but increased natural spread of scrub may be an effect, as well as a cause, of a lowered water table. Even some of the southernmost dune slacks, far from the wooded areas, were recorded as being dryer than formerly, years before the recent expansion of woodland; this drying-out has been blamed for the local extinction of several bryophyte species (Duncan, 1966; Chamberlain, 1979). Hydrology is controlled by complex interactions between factors, including climate, artificial drainage, vegetation, and possibly cutting-back of the dunes by marine erosion, which could influence the potential for lateral seepage. However, drying is also a normal natural process as dune slacks mature, and with little fresh new slack development because the parabolic dune systems have largely stabilised, the amount of wet slack habitat is likely to decline even without external influences. In 1997 six dip-wells were installed to monitor groundwater levels, but these were abandoned after being repeatedly vandalised.

Several ponds have been dug by the army in the northern part of Barry Buddon, including Barry Loch, originally excavated in 1992/93 as a borrow-pit for two range stop-butts, and later modified and deepened as a watermanship and bridging training asset and conservation area, completed in 1995. Close by is the Yeomanry Pond, originally created in September 1996 as a scrape for waders (McCurley, 1997), although, through lack of management over the following five years it developed into more of a pond than a scrape, until it was reprofiled in November 2003 (McCurley and Brennan, 2004). It is intended to maintain the pond as a scrape in future, and the provision of seasonal access for cattle is part of the management for waders. Close to the firing-ranges is the 'River Crossing', or water obstacle, a long sinuous pond excavated for army training use around 1979, which was colonised by sticklebacks and other pond life within weeks (Ellwood, 1981a,b). An older, natural, freshwater pond south-east of Buddon Camp was used by the army for a time as a rubbish tip, although dumping ceased in the 1970s. This pond has now been invaded by willow and frequently dries out. In the south, near Buddon Ness, the 'Lighthouse Pond' was a dune-slack pool, always liable to seasonal drying.

The southern half of Barry Buddon is generally drier than the northern half. A few of the dune slacks are still very wet, with over 4 ha of *Phragmites australis* reedbeds present in the 'lagoon' at the mouth of Buddon Burn and south of Buddon Camp (at one time used as the army's watermanship area, more unkindly known locally as 'Stinkey Holey'). The 3 ha 'Barry Links Lagoon' at the mouth of the Buddon Burn - one of only a very few coastal lagoons on the east coast of Scotland - was included in the MNCR survey of Scottish lagoons (Covey *et al.*, 1998), but the St Helena reedbed to its south-east was not surveyed, although it almost certainly meets the definition of a lagoon: the sandbar separating it from the sea is certainly overtopped on some tides, and the salinity of the pool within the reeds will therefore be variable. However, this stretch of the coast is undergoing erosion, and the sandbar is soon likely to be permanently breached in any case.

Both the Buddon and Barry Burns exhibit classic meanders as they approach the coast; measures to protect Carnoustie's golf courses have restricted movement of the Barry Burn, but the Buddon Burn remains in a largely natural state, its meanders (together with abandoned meanders) incised into the floor of a wider valley. A small saltmarsh is present in the 'lagoon' near the mouth of the Buddon Burn, and a smaller one at the Barry Burn. Both of these are much less than 1 ha in size (Burd, 1989), although the latter example would have larger before the development of Carnoustie's golf courses. Until the 1970s, the Barry Burn saltmarsh was subject to occasional small-scale turf-stripping, but the areas involved (a few m^2) were left in largely natural condition, and never subjected to the prior preparation used for commercial-scale turf harvesting elsewhere (Boorman, 2003). Following expansion

of the golf courses and the cessation of sheep grazing, the tiny area of saltmarsh remaining at Carnoustie today supports grass which is much coarser and more uneven, and unsuitable for such use.

5. Erosion and Coastal Defence

Two major erosional processes operate at Barry Buddon: wind erosion has been responsible for giving the dunes their present form throughout the Links, and is discussed under 'Geology, Soils and Geomorphology' above. But with the dunes now mostly vegetated and fixed, the influence of wind is largely limited to the beach and the dunes immediately behind it. Marine erosion has been the main factor shaping the peninsula in recent years.

A dynamic coastline

The raised beach cliff at Barry shows Barry Buddon and adjacent coastal lowlands to be an emerged coastline, formerly under the sea. But it is also a dynamic coastline, and for centuries since its emergence, it would appear that the northern coast of the Firth of Tay has been in retreat, while Tentsmuir, its southern counterpart on the Fife side, has extended eastwards by several kilometres since prehistoric times (by over 1 km at Tentsmuir Point between 1812 and 1990 alone, with the greater part of this growth since the 1940s (McManus, n.d., b)). Tentsmuir is now the largest dune system in Britain. A common interpretation, repeated by several authors, is that the tidal flats of Monifieth Bay were once land, with Lady Bank, south of Broughty Ferry, marking the probable original coastline. Jervise (1857) and Warden (1884) even record a legend that Lady Bank is the site where a chapel once stood, Jervise adding that it is said that it was "anciently the site of a forest"[13].

In the *Old Statistical Account*, it was estimated that over the preceding 40-year period since around 1750, 50 acres (over 20 ha) of links and dunes between Monifieth and Buddon Ness were lost to the sea in Monifieth Parish alone - which constitutes only a relatively small part of the whole area (Roger, 1791-99). Accounts suggest that this erosion continued throughout the 19th and 20th centuries (Warden, 1884; Simpson, 1888), Warden referring to "great encroachments" to the links between Broughty Castle and Buddon Ness: "In some places quite fifty feet of them have been washed away within the last few years". Mitchell (1997) records that high-water mark at Monifieth retreated northwards by some 30 m between 1959 and the 1990s. Army buildings constructed high on the dunes as recently as the 1940s were reduced to concrete remnants on the foreshore by the 1970s, and today lie well below high-water mark in Monifieth Bay.

Yet even the earliest surviving maps covering the area, surveyed by Pont (n.d., ~1583-96), Gordon (n.d., ~1636-52) and as published in Blaeu's *Atlas* (Gordon, 1654; Pont, 1654), show a distinct bay between the distinctive fortified headland of 'Bruchtie' or 'Brugh-Tay' and the Buddon peninsula. Although this bay is less obvious in Edward's (1678a) first map of Angus, it is clear in Marr's (1666) earliest manuscript chart, while more finished published charts (Collins, 1693; Marr, 1734[14]) also show the northern coastline of the Tay in broadly its present form, as do Adair's maps (n.d., 1703), surveyed around the same time. Victorian maps indicate that the land suffering recent erosion pressure at Monifieth Esplanade had been previously claimed from the sea by landfilling (OS, 1896; Mitchell, 1997).

It is therefore likely that the changes observed have been part of a continuous process of erosion and deposition - but erosion events are always more likely to be recorded for posterity; erosion is reported in most descriptions of the local coastline, while very few mention gains from the sea. The Royal Commission on Coast Erosion (1911) recorded that, between 1850 and 1911, the coastline between Buddon Ness and Broughty Ferry had lost 56 acres (22.6 ha) and had gained 46 (18.6 ha) - a net loss, but hardly as dramatic as the former figure alone would imply[15].

This is consistent with Ferentinos and McManus (1981), who described little change in high-water mark between 1854 and 1950, slight erosion at Buddon Ness being offset by accretion at either side. On the east-facing Barry Sands, Mitchell (1997) records general accretion between 1865 and 1959, reaching as much as 150 m or more at the northern end. Edwardian postcards of Carnoustie Beach show many embryonic dunes developing here. As Valentine (1912) observed, "at this part of the shore…the sea gives up again much of what it carries away".

Spits or peninsulas of one sort or another form naturally at the mouth of many estuaries where there is a convergence of coastal currents transporting sand in one direction and river currents moving sand in another, and though they may be highly dynamic, it is rare for them to disappear entirely, which might be expected if erosion was the only process at work. However, caution is essential when estimating the extent and rate of change from maps - marine charts are little concerned with accurately representing terrestrial features unless important for navigation, while early land surveyors faced particular difficulties in coastal areas where there are few landmarks suitable for trigonometry. Multiple possible sources of error persisted well into the 19th century, even into the era of the Ordnance Survey (Carr, 1962).

Within Monifieth Bay, eroded sediment is carried westwards towards Broughty Ferry Castle (Al-Mansi, 1986, 1990), a pattern made evident by the persistent accumulation of blown sand at Broughty Ferry Esplanade; material is even circulated to the inner Tay estuary (J. McManus, quoted in Mitchell, 1997). This anti-clockwise

Figure 3

Ruins of a World War II pillbox on Monifieth Links, destroyed by coastal erosion.
Illustration by Colin Gibson, drawn during the 1950s.

movement has sometimes been attributed to the outflow of the Buddon Burn, but in fact the direction of the Burn's current is much more likely to be influenced by more general tidal circulation within the Firth of Tay; the smaller Monifieth Burn and the larger Dighty both also turn westwards at their mouths, though to a less marked degree. The mouth of the Buddon Burn is itself shaped by this circulation. Bailie's (1826) plan shows only a slight westward deflection at the mouth of the Burn, but by the early 20th century a sand spit had become a prominent and persistent feature. The spit extends westwards, and re-forms following a similar pattern even if breached. By late 2003 the spit had extended farther westwards than ever previously recorded, well beyond the boundary of the MoD land, reaching as far as Monifieth's Riverside Caravan Park, so that the outlets of the Buddon and Monifieth Burns were only about 100 m apart; two years later the outflows had fully converged.

Surprisingly, the concrete sea-wall (the 'sloping masonry') constructed to protect the battery south of Buddon Camp (see below) is sited to the west of the battery, facing WSW. This suggests that, before the 1920s, the dunes experienced erosional pressure in the opposite direction from today. It is unlikely that the tidal circulation has completely reversed; perhaps the prevailing westerly winds blowing down the Firth of Tay exerted greater influence on the shore at that time, or perhaps the sea-wall was built in response to an isolated and untypical storm event.

Historically, the coastline around Buddon Ness itself has undergone greatest change, which reflects its exposed location at the point where the south-facing estuarine coastline changes to an open North Sea orientation. The Ness formerly lay south-east of its present point, towards the Gaa Sands at the mouth of the Firth. Geikie (1887) wrote that "the lighthouses which were formerly erected at the southern extremity of Button Ness [*sic*] have been from time to time removed about a mile and a quarter [2 km] farther northward, on account of the shifting and wasting of these sandy shores. The spot on which the outer lighthouse stood early in the seventeenth century, was found to be in 1816 two or three fathoms [4-6 m] under water, and at least three-quarters of a mile [1.2 km] within flood mark". Geikie's assertion is repeated by Currie (1970, cited in Wright, 1981), who wrote "in 1816 the point on which the [original] outer lighthouse stood was 6 m under water" and that "...the original lighthouses erected on the southern extremity of Buddon Ness at the beginning of the 16th century...had to be moved 2 km to the northwest". Later authors have repeated these assertions, yet there is room for doubt over the actual extent and rate of coastal retreat[16]. Firstly, there is good evidence that no beacon existed before 1687, some 50 years later than claimed by Geikie (1887), and 150 years later than claimed by Currie (1970). Secondly, it could be inferred from Blackadder's (1826) map and the architectural evidence of the lighthouses that the coastline retreated by around 700 m between 1687 and 1826, with a slower rate of change thereafter (see 'Lighthouses' below). The Low Lighthouse, being closer to the sea, has always been

more vulnerable to coastal changes; the inner High Lighthouse is a more stable reference point, and some error may have been introduced by confusing the two (although both Geikie and Currie are careful to refer to the 'outer lighthouse'). The true amount of coastal retreat could have been even less than 700 m - it is quite likely that, having lost one lighthouse to the waves, its replacement was built far enough inland to give a considerable safety margin[17]. Slightly farther to the west, the position of the coastline relative to the ice-house would appear to have changed little since it was first shown on Horne's (1842) plan. However, the lifeboat-house, which according to Gibson and R.T. McLeod (pers. comm.) was near to the ice-house, and which survived well into the 20th century, has long since been lost to erosion. It would appear that even this lifeboat-house was not the original building, as Stevenson's (1847) plan shows the lifeboat-house farther to the south-east, on the coast between the two lighthouses; being necessarily sited very close to the beach, it will always have been more vulnerable to erosion, perhaps even from single storm events.

Even at the point of Buddon Ness, erosion has not been constant: Mitchell (1997) records the Ness showing a mixture of advance and retreat between 1865 and 1903, but serious retreat of up to about 260 m between 1903 and 1959. After 1959, the eroding zone moved northwards along almost the whole east-facing coastline of Barry Sands, eventually prompting the construction of major coastal defences (see below). Currie (1970, cited in Wright, 1981), noted that as a result of marked erosion along Barry Sands and at Buddon Ness, St Andrews in Fife had become visible from Carnoustie railway station. Assuming that the view had previously been obstructed by the immediate hindshore dunes, plotting of sightlines suggests a retreat of perhaps as much as 300-400 m at the southern end, a greater amount of erosion than is suggested by Mitchell (1997).

It is the natural state of affairs for sand dunes to form, move and be eroded, and sediment transported downstream by the Tay (around 1 million tonnes in a dry year (Al-Jabbari *et al.*, 1980), much more in wet years (McManus, n.d., a)), or recirculated by the sea, helps to replenish the system. Nevertheless, the formation of many coastal dune systems benefited from unprecedented availability of sediment during the glacial and post-glacial periods, and from falling relative sea levels. The reduction in sediment production, combined with rising sea levels and other factors, means that more recently, net erosion has been a widespread phenomenon affecting many dune systems in Scotland (Robertson-Rintoul and Ritchie, 1990) and globally (Bird, 1987). Around the 1970s, the Angus coastline generally changed from being a primarily accreting coast to a primarily eroding one, with wide-scale changes to the North Sea wind and wave climate being likely contributory factors to an increase in south-easterly wave conditions (Mitchell, 1997). The Firth of Tay is untypical in that at least one of its dune systems, at Tentsmuir, is still undergoing rapid net growth - a

condition now shared with less than 10% of the world's sandy coastlines (Bird, 1987). It should not be assumed that Tentsmuir's growth is directly at the expense of Barry Buddon, as the main sediment supply lies offshore (McManus and Wal, 1996). In any case, in a few places, or for a few years, the general trend is reversed; new dunes or sand-spits begin to accumulate on the northern shore of the Firth, while local erosion occurs at Tentsmuir (most markedly in recent years along its northern coast, but also on parts of its east-facing coast).

The natural evolution of the local coastline may have been disrupted in the 1940s when the Tay shipping channel was dredged to produce a more direct east-west orientation. Previously, shipping had approached the Tay from the south-east, despite earlier attempts in the 1880s to dredge an easier channel. Since the channel was dredged, it has migrated northwards, and some recent coastal changes may reflect the re-establishment of a natural channel alignment (Ferentinos and McManus, 1981; McManus, n.d., a). A secondary deepwater channel has moved northwards, allowing waves to break much closer to the shore near Monifieth, and the increased wave energy is considered to be a major factor in the erosion of this area since the 1970s (Caledonian Geotech, 1987). Barry Buddon is one of several dune systems subject to a Coastal Zone Management study by Glasgow University for Scottish Natural Heritage, assessing the rates and causes of change in Scotland's beaches and dunes.

Coastal defences

Unfortunately, human land-use and ownership is less able to adapt to the winds, waves and currents than the natural coastline, and efforts have been made over many years to control erosion, where the dunes or the area landward support economic assets. Some fanciful ideas have been suggested, including the erection of training walls to constrain the Dighty and Monifieth Burns (Simpson, 1888), but until the late 1980s most attempts had been small-scale and local, initially concentrated on the shore to the west of Barry Buddon near Monifieth. There are particular problems here, as the railway runs along the top of the shore at the west end of Monifieth Sands; farther east, caravan parks and other developments have been squeezed between the railway and the beach. Also at Monifieth, these pressures were exacerbated by mismanagement at the coast. From Victorian times until as late as 1975, foundry waste and later domestic rubbish were ill-advisedly dumped over the dunes of Monifieth Links, right up to the top of the beach[18], while some of the surviving dunes were bulldozed in the 1950s to make a recreation ground (Elder, n.d.). As well as wider-scale erosional pressures, Monifieth Bay is subject to local currents from the Dighty Water, Buddon and Monifieth Burns, and even while dumping continued, rubbish was being washed onto the sands, ruining Monifieth's popular beach.

Although Mitchell (1997) describes coastal protection at Monifieth as first being

attempted in the 1970s, efforts to control erosion had been made many years earlier. A particularly dramatic erosion event in 1908, which affected Monifieth's dunes and the army rifle range at Monifieth Links, led to the construction of a complex of wooden groynes and breakwaters and "a wall of piles" (Malcolm, 1910). At first these were maintained by a team of joiners, before being allowed to decay. Although local people recalled 'the Breakers' as being effective at protecting the coast, as well as being good windbreaks and bathing-shelters, many were in fact badly damaged soon after they were built, by another severe erosion event in February 1912. They were removed in the 1930s to allow motor-racing and motorcycle-racing on the sands. A single experimental concrete groyne was built out from the eroding landfill site in the 1970s; like other ad hoc efforts (the dumping of loose building rubble down the 'cliff', and later the construction of a wall of rubble-filled wire gabions), it failed to save Monifieth's once-sandy beach. None of these measures could have been effective in this situation (SNH, 2000), and in fact merely added more debris to the problem, while the groyne, by cutting off the supply of sediment from the east, may even have exacerbated erosion to its west. In 1980, the Frigg No. 3 gas pipeline was laid under the Tay between Monifieth Links and Tentsmuir, necessitating the construction of a temporary rock causeway across the sands; while it remained in place, it diverted the current away from its normal westward direction. After pipeline was completed, the causeway was dismantled, the 24,000 tonnes of boulders being re-used to protect the rubbish-tip from erosion. Soon afterwards, in 1983/84, rip-rap coastal protection was installed to protect the caravan parks and esplanade, and further rock armour was put in place in 2003.

Farther east, at Barry Buddon itself, the army initially adapted to erosion simply by moving the firing ranges back before the sea's advance, but during World War I, measures were needed to protect the gun battery south of Buddon Camp. The Buddon Burn broke through its sand-spit at some date between 1903 and the 1930s (Mitchell, 1997), perhaps indicating erosion pressure on that part of the coast, and the loss of the buffering effect from the spit may have made the battery more vulnerable. A sloping concrete sea-wall was built above high water mark, fronted by an apron of stone slabs (presumably intended to prevent the wall from being undermined) held in place by a low wooden fence (R.T. McLeod, pers. comm.). Later, around the late 1920s or 1930s, 'Dutch fences' of wire interwoven with branches were erected on the upper shore to gain land in this area. Sand collected against these, and soon 50-100 m of dunes had built up. Boase (1962) estimated the addition to the land surface (presumably measured along the coast) to be "about three furlongs" (over 600 m). In the slack behind the new dunes, a marsh developed. Boase (1962) noted that this saltmarsh and lagoon did not exist until 1925, yet by 1946 it supported a significant reedbed, and a small alder wood soon developed. It is questionable whether even the army's concrete wall could have held back the sea if the waves and currents had continued to attack in that direction. The wall itself is substantial, but extends

for only a short length, while its fronting slabs would be effective only in a low-energy wave environment. The rapid gain resulting from sand-trapping by the flimsy Dutch fences suggests that marine erosion was no longer a major factor here, and that any continuing instability resulted from wind rather than wave action. About 1950, the easternmost portion of the new land was eroded back to the old shoreline, an event which coincided with the development of new high sand dunes to the west at Monifieth (Mitchell, 1997). Since then, despite occasional gains, the trend has been one of continuing erosion, which has removed much of the new dunes, and is rapidly encroaching on the reedbed and wet woodland.

In the eastern part of Barry Buddon, an attempt to stabilise some 600 m^2 of dunes on the Sandy Downs was carried out by the Scottish Conservation Projects Trust in the 1990s, using chestnut-paling dune-fencing and planting of Marram *Ammophila arenaria*. The rationale for this work is unclear, but seems to have been a short-term effort to limit the loss of sand downslope as the adjacent coastline was eroded, rather than to prevent wind erosion or to regain land from the sea.

Other early efforts to tame the dunes have had a wider impact on the natural ecology. Although it has not yet become so widespread as at Tentsmuir, the invasive Sea-Buckthorn *Hippophae rhamnoides* (non-native to Scotland) has been present at Barry Buddon since at least the 1940s (Rechinger, 1950; Gibson, 1954). The origin of the Buddon stands is uncertain (Ranwell, 1972), but it was very likely originally planted to try to stabilise the dunes[19] - its planting was still being advocated for this purpose in the 1970s. Older stands expand by suckering, while younger stands are mainly bird-sown from either locally-produced seed or seed carried from bushes planted at Tentsmuir, although some bushes were being deliberately planted by the army as recently as the late 1970s (Anon., 1978). It also appears to have been encouraged, if not actually planted, even more recently, along the seaward edge of the Buddon Golf Course near Carnoustie.

Since the 1970s, new stands have been developing, while older stands appear to have become both taller and more extensive, perhaps in response to reductions in burning and grazing intensity. Although it may contribute to stabilising the dunes against the effects of wind, the scrub is ineffective at reducing coastal erosion, and is a threat to the natural vegetation of the Links. Woolven (1987) recommended that Sea-Buckthorn should be eliminated for this reason[20] - although its value to wintering and migrant passerines is undeniable.

In the past, some army activities almost certainly contributed to erosion, although training manoeuvres are now more carefully controlled: repeated scalping of the dunes by shellfire may have weakened them (H.R. Wallingford Ltd., 1989), as did army vehicle manoeuvres in several places in the 1970s and probably earlier. Dargie (1993) thought that off-road vehicle damage was probably widespread and severe at

Barry Links, but this assumption was based on experience at other MoD duneland sites, rather than field survey.

The most substantial recent coast-protection works are on the east-facing Barry Sands. Although an accreting coastline until around 1959 (Mitchell, 1997), the northern 4 km of coast has since undergone severe erosion, with the dune face recorded to have retreated by as much as 10 m in 1978/79 alone (Wright, 1981). A succession of increasingly costly efforts have been made to combat the threat to the army firing ranges and the golf courses at Carnoustie. In 1978 a gabion wall was constructed between the Barry Burn and the ranges, reinforced by a rip-rap revetment. These early attempts were rapidly overridden, and were replaced in 1985 by an armoured rubblestone revetment. To build this revetment, sand was taken from the beach, and the dunes near Carnoustie were levelled - damage that may have contributed to the failure of the new revetment within a few weeks. In 1987-89 it was replaced by a boulder revetment over a gabion mattress. In 1993-94, this armoured revetment was extended southwards along Barry Sands from the north Buddon Ranges to the Gaa Sandhill, a total length of some 3.5 km (Mitchell, 1997; Hansom, 1999). In 2003/04, the rock armour revetment was extended eastwards along Carnoustie Promenade, replacing the earlier unsuccessful gabion revetment. Here, the crest level was also raised and topped by a wall to protect the town from marine flooding as well as erosion. The Barry Sands coast protection stops short of Buddon Ness, one reason being to avoid an area of beach that was a favoured tern nesting site (Anon., 1986). Rock armour also extends westwards from the MoD ranges at Monifieth Links, starting near the Buddon Burn; only about 4 km of the coast of Barry Buddon is now unprotected, less than half the total length. Most of the Angus coastline now has a rocky upper shore, either natural or man-made, and at high tide there is now no exposed beach along the majority of the defended sections between Monifieth and Carnoustie. This has removed the habitat on which depends the limited number of plant and animal species adapted to survive on the upper shore and strandline of sandy beaches. Although aesthetically unattractive, the present rock armour appears to be serving its purpose of preventing further erosion along the protected stretch of coast. After an unsuccessful attempt to hydroseed grass (Woolven, 1987), exposed sand behind the eastern rock revetment was planted with Marram *Ammophila arenaria*, but it showed poor vigour in this unnatural situation without an influx of fresh sand[21] (SNH, 2000), and by 2003 much of the disturbed ground had been colonised by a dense growth of Sea-Buckthorn *Hippophae rhamnoides* seedlings.

The rock armour has effectively stopped the coastal dune processes where it is emplaced, but is likely to have an effect far beyond the defended stretch of coastline. Sediment movements within Carnoustie Bay are complex and poorly understood, with significant interchange of sediments between the beach and nearshore seabed,

and even a tendency for a spit to develop northwards at the mouth of the Barry Burn, in the opposite direction to wider sediment drift (Angus Council, 2004). However, on the coast north of the Firth of Tay there is a general pattern of south-westerly longshore sediment transport down the exposed North Sea coast of Barry Sands to Buddon Ness, where deposition occurs. This pattern has been calculated using wave refraction modelling and is supported by field evidence from released gabion fillings (Sarrikostis and McManus, 1987). The extensive coastal protection works along the northern part of this coast will clearly affect the natural balance of the coastal system. Potential sediment supply from the previously eroding dunes to the downdrift beaches (i.e. Buddon Ness) has effectively been sterilised. This has long-term implications for the entire system (Hansom, 2003a), and by early 2003, the unprotected dunes to the south of the rock armour had been cut back by nearly 50 m (almost certainly a more rapid rate of loss than previously), forming a pronounced erosional notch - an effect predicted by Mitchell (1997). Furthermore, the defended sections of coast have undergone accelerated lowering of beach levels since the rock armour was emplaced. This is likely to produce a 'coastal squeeze' effect, reducing the intertidal area and exposing the defences themselves to increased wave energy. Eventually, further measures may become necessary to prevent the rock armour from being outflanked at its southern end (a problem already becoming apparent by the end of 2003), if not to reduce erosion of the unprotected coastline; artificial beach replenishment using sand from farther offshore has been suggested (Woolven, 1987). However, no active intervention is currently planned for the unprotected section of coast, in contrast to the defended sections where the management policy is to 'hold the line' (Angus Council, 2004).

Sea-level rise, and probably even more importantly, greater peak wave heights and increased storminess (Pye, 2001), have the potential to not only impact the unprotected coast but possibly even overtop the coastal defences. While climate change could potentially result in increased sediment supply to the beach, this is unlikely to fully compensate for the resultant damage. The Shoreline Management Plan (Angus Council, 2004) does recognise an opportunity to remove the defences and restore natural coastal processes in the event of the MoD leaving Barry Buddon or reducing their activities, but any such action would need to be subject to a full assessment of the impacts on the adjacent golf courses and infrastructure.

6. Climate

According to Gibson, Barry Buddon has a microclimate of its own. He described how daily weather readings were at one time taken at the lighthouse for the Air Ministry, and on at least one occasion an engineer came from Edinburgh to check for faults in the meteorological equipment. The readings were, however, correct. In

winter at least, and despite the proximity of the sea, Buddon Ness was reportedly often a few degrees colder than nearby areas. Although the peninsula is fully exposed to easterly winds off the North Sea, and also to the prevailing westerly winds blowing down the Firth of Tay, these measurements seem anomalous. Snow rarely lies on these coastal lowlands; monthly average temperatures for Tentsmuir (measured at RAF Leuchars, some 12 km to the south-west) are relatively mild, the average minimum temperature remaining above 0°C even in the winter months, and the average of less than 60 days of air frost being considerably milder than east Scotland as a whole (Met Office, n.d.). The climate of nearby Monifieth has been described as 'moderate' (Elder, n.d.), while Woolven (1987) went so far as to describe Barry Links as "warm and dry with fairly mild winters". The presence of a number of plant and insect species at or near the northern limit of their range (Woolven, 1987) also seems to refute Gibson's report of a colder microclimate. In very cold weather, however, ice drifting down the Tay, or circulating from the mudflats at Tentsmuir, collects around the mouth of the Buddon Burn (as in the winters of 1947, 1963, 1978). Furthermore, on the coast there can be significant differences in temperature over relatively short distances, with noticeable effects on wildlife – across the Tay at Tentsmuir Point, the Green-Veined White butterfly *Pieris napi* regularly emerges about one week later, and has a shorter flight season, than at Morton Lochs which lies about 1 km inland from the shore (Pollard and Yates, 1993), and similar differences have been observed for Ringlet *Aphantopus hyperantus* (Kinnear, 1982). Characteristic weather features shared with much of the east coast are a cold sea-breeze and haar (sea mist), both of which tend to arrive at Monifieth around the same time in the afternoon as Dundee picnickers!

7. History and Land Tenure

Prehistory

Barry Buddon contains no known examples of the ancient hut-circles, shell-middens and other archaeological remains that are found in many Scottish sand-dune sites, and that were a notable feature of Tentsmuir until largely obliterated by afforestation and agriculture after World War I (see, for example, Paul, 1905; Hutcheson, 1907, 1914; Shand, 1907; Ritchie, 1929; Lacaille, 1944; Coles, 1971; Candow, 1989). In contrast to Tentsmuir, which has produced numerous finds, no prehistoric artefacts seem to be recorded in museums except for two spindle whorls "from the Sands of Barry", now in Dundee Museum (Coutts, 1971), and there are no descriptions of archaeological finds in the literature. Yet Barry Buddon is the older of the two peninsulas, the whole of Tentsmuir having accreted within the last 6,000 years. Furthermore, it would seem that a larger proportion of Barry Buddon remained unsuitable for cultivation and therefore undisturbed by agriculture, so any remains

present should be better-preserved. Certainly Boyd (1977) speculated that "the richness of Tentsmuir in Mesolithic material may well be echoed on the Angus side of the Tay at Buddon and further north". While it is the case that not all the dune sites north of the Tay have provided Mesolithic artefacts such as those found at Tentsmuir (Lacaille, 1954), Barry Buddon seems to be almost unique in having virtually no recorded remains of <u>any</u> age before the 19th Century. It may be that the same limitations on access that led to Barry Buddon's natural history being relatively poorly-studied (see 'Research and Conservation' below) have also limited field archaeological studies, so that the Links might prove a fruitful area for further research. To address this lack of knowledge, a study has recently been undertaken by MoD Defence Estates' Archaeological Advisor.

The lack of archaeological remains may reflect a genuine absence of early settlement at Barry Buddon. Historically, Tentsmuir's dunes seem to have been generally more stable than those north of the Tay, with permanent settlement following behind the coast as it extended eastwards. This is apparent from many early maps, for example Ainslie (1775), showing Tentsmuir as being well-settled with many named farms, at a time when Barry Buddon had few if any buildings between Cowbyres and the lighthouses. Possibly Buddon's mobile sand dunes discouraged permanent settlement. Or perhaps the retreating coastline and drifting sands destroyed any remains that were present - although abundant archaeological evidence has survived in equally dynamic dune systems elsewhere. Or perhaps relics survive buried deep below the present surface - stoneware bottles of no great age have been found covered by more than 1 metre depth of sand at Monifieth Golf Links (Gibson, 27.04.1991), while around 1820 an ancient canoe was uncovered during the digging of a deep drain east of Monifieth (Miller, 1845). In some places closer to the sea, recent cutting-back of the dunes by coastal erosion has revealed modern strandline debris including plastic bottles buried by sand to a depth of 2 metres or more.

A reading of Ochterlony (1682) would give the impression that there <u>were</u> prehistoric remains on the Links at one time. He wrote excitedly how the Parish of Barry "…is famous for that great battle fought betwixt the Scots and the Danes in the Links of Barrie, wherein the Scots obtained the victorie, with great slaughter of both Scots and Danes, which is to be seen at this day by the great heaps of stones casten together in great heapes in diverse places of that Links which is said to be the buriall of the dead there slain." Mingling several legends and fragments of Dark Age history, Ochterlony goes on to relate how, in the aftermath of the battle, Camus, the Danes' leader, was killed some miles to the north[22], leaving the remainder of his force to be routed at Aberlemno. There is a tradition that the slaughter was such that the Lochty Burn, which rises near Monikie and joins the Barry Burn near Carnoustie, ran with blood, commemorated in a local couplet:

"Lochty, Lochty, is red, red, red,
For it has run three days wi' bluid."

Many subsequent authors have repeated the story, with minor variations, and the Victorian Ordnance Survey surveyors believed enough of the legend to mark "Supposed site of battle between the Scots and Danes 1010" on the 1858 six-inch map, locating it near the centre of Carnoustie. Jervise (1857), without giving any examples from the Links, says "it is certain that great quantities of tumuli and rude stone coffins have been found along the sands of Barry and Carnoustie".

In fact, Ochterlony merely borrowed from a lengthy, and apparently fictitious, account by Hector Boece (1526), whose family held the neighbouring Barony of Panbride. While there could well be some truth behind the stories of a Viking attack around the 10th century, and Barry Sands would have made an ideal landing-place for invaders, there is the problem that not only are there no 'great heapes of stones' on the Links today, but it would be difficult to find enough natural pebbles on Barry Buddon to build even a small cairn. The legend seems to have invented to account for the finding of prehistoric burials in the Carnoustie area. The 'site of a cairn' is mapped in front of the old raised beach cliff just east of Barry Manse at approximately NO 536 342 (OS, 1968), near to where recent survey has identified a sequence of ditched enclosures (Rees and Cameron, 1998), and finds at Carnoustie itself have been authenticated. Although the story of a battle is sometimes repeated even today, historians doubted the veracity of Boece's account as early as the 19th century, and Atkinson (1987) comprehensively demolishes and discredits it. Furthermore, Jervise (1857) and Warden (1881) put the location of the main archaeological remains several kilometres north-west of the Links, at Carlungie. It is one of many stories of mythical or semi-mythical battles that crop up around Scotland, often involving 'the Danes' – similar tales are associated with Tentsmuir on the opposite shore of the Tay (Hutcheson, 1907, 1914). Yet Ochterlony's seat at Guynd was only some 10 km north of Buddon Ness, so he might be expected to have at least a good second-hand contemporary knowledge of the Links. It is necessary to remember that Ochterlony is describing the links as they were in his day, when they extended as far inland as the old raised beach cliff, and along almost the entire coast from Arbroath to Broughty Ferry. Prehistoric remains much farther inland than the area now regarded as Barry Buddon could have been described as being on Barry Links.

Monastic landholdings and the Reformation

The early historical record is summarised by Warden (1881). Although, before the Reformation, much of the county of Angus was held by the Abbot of Arbroath, almost the whole Parish of Barry[23] had been conferred upon the Abbey of Balmerino in 1229, around the time of its foundation, by King Alexander II. Until then it had been Crown land, and indeed a Royal residence at the time of the gift. In 1234 Alexander II granted a further charter bestowing the Abbey the right to hold the lands of Barry as

'forest' or 'free forest' including the rights of hunting, hawking, and all kinds of game (Campbell, 1899). Poaching could incur the very heavy fine of £10 (Gilbert, 1979), and there were controls on the cutting of wood and probably the rights to pasturage.

As maintenance of Barry Church remained the responsibility of Arbroath Abbey, compensatory arrangements were put in place to ensure that Arbroath Abbey was not disadvantaged by not having the income from the surrounding parish. At first Balmerino Abbey was required to pay the Abbey of Arbroath the tithes for the land they has acquired, at the value when acquired; however, by 1233 Arbroath Abbey had surrendered the tithes to Balmerino in exchange for a fixed annual payment of 40 merks (about £2.20 in modern money). In a further act of generosity, on Christmas Day 1235 Alexander II bestowed upon Arbroath Abbey some 1,980 acres of land at Tarves, Aberdeenshire, of much greater value than the tithes of Barry. This endowment enabled Arbroath Abbey to release the brethren at Balmerino from liability for any annual payment (Campbell, 1899).

Religious foundations rarely used land distant from the abbey directly - often it would be let to tenants to generate income. In the 16th century, church lands began to be widely feued, frequently enabling tenants to become proprietors - overall, some 60% of Balmerino's lands were eventually granted to resident occupiers (Sanderson, 1982). Many (though not all) subsequent changes of ownership and tenancy are recorded in surviving legal documents. These documents show that the landward portion of Barry Links supported agriculture from an early date, with many named steadings. Some of these names even give a hint of the types of farming practised, for example Cowbyres, Ryefaulds, Shepherds Lands, Wether Meadows. Interpretation of records from after the Reformation is complicated by the fact that the Barony of Barry, the Bailiary of Barry (both of which referred to the entire parish, the Bailie being responsible for administering the Barony), and the feus could all be, and often were, held by different individuals; the feuars could let their land to tenants, who might in turn have subtenants, and at the bottom of the hierarchy there would be the cottars, granted a small piece of land in exchange for their labour. All these landholdings could be subject to a variety of terms and conditions, but only those responsible for paying rent are at all likely to be recorded.

In 1545, Walter Cant obtained by charter from Balmerino Abbey a major part of the links of Barry and Cowbyres, with the pasturage and vicarage tithes. These are recorded in a rental (feu-duties) list of the Abbey's properties in Angus, dating from the time of the commendatorship of Henry Kinneir (or Kinnear) (between 1573 and 1581): "The lands of the Links of Barrie, wt ye pertinents. viz. the half of the lands of Saltgirse *alias* Shepherd's Lands, the halfe of 4 aikers called Bowman's lands, the halfe lands called Corsefauld. Halfe lands called Ryfaulds, and half of the walleys and pastuarage. The halfe of ye tofts, barns & c. wt ye teinds, & c. And Cowbyre wt ye meadow & teynds yrof, except ye teinds due to the vicar, set to Cant for, viz. - For ye Links, £20 and 20s of augmentation: Cowbyre £1 13 4d, and 6s 8d Inde." Previously,

at some date during the time of Abbot Robert (1526-1559), the Cants had acquired part of the lands of Pitskelly, to the north of Barry Buddon (Warden, 1881). Thus Cowbyres became part of Pitskelly Estate, and remained so through several changes of ownership over the next three centuries. The Cants retained Pitskelly until sometime shortly after 1629, when the whole estate was purchased by James Alexander. By 1741, the Laird of Balskelly [Pitskelly] was Alexander Hunter.

In 1552, half of the lands of Buddon, Buddon Links and Deyhouse were feued by the Abbey of Balmerino to Robert Forrester, a charter confirmed by the Archbishop of St Andrews in 1554. The reddendo to be paid by the new owner included the furnishing of a house at Barry for the Abbot and his factors when they held court at Barry. It is recorded that, near Deyhouse, there was a piece of land called Abbot's Horseward or Abbot's Horsewaird, which may have been an enclosure for keeping the Abbot's horse on these occasions; or it may have been land used for rearing horses (Campbell, 1899) (see 'Agriculture and Crofting' below). Later papers show that the Forresters continued to hold their portion of the Links for several generations. In April 1632 John Forrester of Deyhouse, son of Robert, "was restored in the lands of Buddon, with the links of the same and teinds, with the lands called Abbots horseward". In July 1661 John Forrester's grandson (also called John) "was restored in half of the Links of Barry with pendicles, viz part of Saltgrass or Shipstands, or Shepherd's land, Barrow, or Bowman's lands, Croecefaulds, Ryefaulds, and Wether Meadows" (Warden, 1881). It is curious that while most of the place names referred to lie within the western half of the Links, Deyhouse is in the east. It would appear that the Forrester's estate was divided by the Cant's Cowbyres lands.

Soon after this date at least part of the Forrester's lands was acquired by the Earls of Panmure. George Maule, 3rd Earl of Panmure, died in 1686 and his brother James Maule (1658 - 1723) inherited the title and estates. In April 1686 it was recorded that James was restored in, amongst other properties, "lands of Baskellie [Pitskelly]...the maritime plains of the Linkes of Budden and Dayhouse, lands of Cowbyres...lands of Budden and lands of Carunslie [Carnoustie], with fishings of Buddinge..." (Warden, 1880, 1881). The inclusion of the Pitskelly/Cowbyres lands indicates that by this time, the Earls of Panmure had obtained superiority (in effect, freehold) over the whole of Barry Buddon, entitling them to receive annual feu duties in respect of these properties. However, it would be another 167 years before the Earls enjoyed proprietorship proper across the whole peninsula. An early action by James Maule, in 1687, was to feu ground to the Seamans' Fraternity of Dundee for the erection of lighthouses at Buddon Ness (see 'Lighthouses' below).

A third charter from Balmerino Abbey feued the Town and lands of Carnusie [Carnoustie] to a person named Fairney, who also feued Grange of Barry and other lands. This transaction may have included part of the most north-easterly portion of

the Links, much of which has perhaps since been lost to the sea, but it is clear from the 1545 and 1552 charters that Walter Cant and Robert Forrester had each acquired approximately half of the area. The monastic charters of the mid-16th century established a boundary line running north-south across the links that was to last until the mid-19th century. Perhaps intended to ensure that the purchasers each received a share of the more fertile inland portion, grazing land and foreshore, as well as the barren dunes, this division of ownership was to lead to protracted boundary disputes amongst later generations - valuable salmon fishings were worth defending through litigation.

Balmerino Abbey was sacked during the Reformation in 1559. From 1560 a succession of Commendator-Abbots were appointed, and the right to grant (or withdraw) the lands of Barry was once again Royal prerogative. Such changes effectively applied to the superiority, or freehold, and would not necessarily affect the occupier of the land. In 1587/8 King James VI gave the lands and barony of Barry to James Meldrum of Segy, apparently as security for a royal debt of £10,000 incurred in the public service. There is no further mention of this in the records, so Meldrum's possession of Barry seems to have been brief (Campbell, 1899). A more significant grant came in 1590, when the king gave the office of the Bailiary of Barry to Patrick Maule as a hereditable gift "which had been used and exercised by Sir Thomas Maule of Panmure, Knight, and his successors by virtue of the letters of tack made by the Commendators of the Abbey of Balmerino past memory of man"[24] (Maule, 1874). However, only a few years later, in 1599, the king bestowed the Bailiary of Barry upon his secretary, Sir James Elphingstoun of Barntoun (later Lord Balmerino); the following year the king additionally granted the Barony and lands of Barry, with the salmon-fishings, to Elphingstoun and his heirs. Not until 1667 did the Earl of Panmure reacquire the Bailiary from Lord Balmerino (Campbell, 1899).

After the Reformation

Ainslie (1794) records that the occupier of Barry Buddon was 'Hunter Esq.' Alexander Gibson Hunter inherited Pitskelly Estate by 1810 (Webster, 1810), and died by 1822, when the estate of Pitskelly and Cowbyres was being administered by trustees (Commissioners of Supply, 1823). He may have had some sort of lease over the remaining portion of the links, but it is possible that Ainslie overstated the extent of Hunter's lands. To the north-east of the Barry Burn, near Carnoustie, there appears to have been an area of common land (Ireland, 1794), perhaps used for common grazing. The people of Monifieth may also have had common grazing rights (Fraser, 1995).

Blackadder's (1826) plan shows Barry Buddon divided into three sections, still corresponding to the division in the original abbey charters: William Maule, Lord

Panmure, owned Buddon in the west and Deyhouse in the east, while David Hunter of Pitskelly had inherited the central section around Cowbyres, a broad strip tapering southwards towards the coast and dividing the Panmure holdings. Hunter's land around Cowbyres was feued as pendicles (crofts) to various tenants - named occupiers of the northern portion of Barry Buddon at this time included Mr Gardyne, Miss Johnstone, W. McLeish, Mr Milne, Mrs Moram and David Young, several of whom continued to be listed amongst the principal landowners in 1843 (Warden, 1881). At the same date, Bailie's (1826) plan of Buddon shows a significant part of the Panmure land divided into fields with straight boundaries and what are presumably croft buildings. Pencilled annotations added after drawing the plan show that W. Butchart, James Scott and Thomas Mitchell had each acquired 4 acres (1.6 ha) of adjacent newly-enclosed land. However, by the 19th century, the coastal salmon fishings were becoming much more valuable than the rents that could be obtained from agricultural tenants making a precarious living on poor soils.

While Forrester's portion was the first part of Barry Buddon to be absorbed into the Panmure Estates, in the second half of the 17th century, it was not the last - although the expansion of the Panmure Estates had not been uninterrupted. The extensive estates of the Earls of Panmure were forfeited as a consequence of the 4th Earl's involvement in the 1715 Jacobite Rebellion, and were acquired by the York Buildings Company in 1719 for over £60,000 (Millar, 1909). They were bought back by the 4th Earl's nephew William from the creditors of the York Buildings Company (which had gone into liquidation) at auction in 1764, at a cost of just under £50,000 (Anon., 1764). William died unmarried in 1782, and the Panmure Estates passed into the Dalhousie family through the marriage earlier of his eldest sister, Jean Maule, to George, Lord Ramsay, eldest son of William, 6th Earl of Dalhousie. The Earl of Dalhousie thus became the county's major landowner at a time when the Agricultural Revolution was beginning to produce rewards, enabling further expansion of the estates. However, it was not until 1853 that Fox Maule Ramsay (1801 - 1874), 2nd Baron Panmure (later 11th Earl of Dalhousie), by the purchase of Pitskelly estate from David Hunter (grandson of Alexander Hunter), was able to bring the whole of Barry Buddon back into single full ownership for the first time since it had been sold by the Abbot of Balmerino in the 16th century. The Earls of Dalhousie were to enjoy this exclusive occupancy for less than 40 years, and even at the end of that period, the division of the links into three portions as established by the Abbey charters was briefly revived.

In 1891, to secure its training ground, the War Department compulsorily purchased Buddon and Deyhouse, including a 1 km-long stretch of Monifieth Links, and completed its purchase of almost the whole of Barry Buddon with the Pitskelly

portion in 1893 (see 'Army' below). The 13th Earl of Dalhousie had died in 1887, and his son, Arthur George Maule Ramsay, the 14th Earl (1878-1928) was still a minor at the time of the sale. His representatives claimed £88,500 for the land and fisheries affected (Robinson, Raper and Ramsay, 1891) (against just £28,000 offered by the War Office), and received an eventual settlement of £43,000 (Dickson, 1892). This bought some 1,388 ha of links, foreshore and plantations, plus around 60 ha north of the railway, and the salmon-fishing rights.

Carnoustie had become a Borough in 1889, and one of the Council's early actions, in 1891, was to raise £1,350 to purchase the north-eastern corner of the Links for golf and other leisure activities - saving the Dalhousie Golf Club, which had been threatened by the army takeover. Further land came under golf 90 years later, following a government-commissioned review of the MoD's countryside and coastal landholdings by the House of Commons Defence Lands Committee, chaired by Lord Nugent of Guildford. The Nugent Committee's report, published in July 1973, recommended that about 50 ha of MoD land should be released to expand the golfing facilities at Carnoustie - a recommendation accepted by the government in a White Paper in August the following year. As a result, in 1981, Carnoustie's Buddon Links Course was laid out on land purchased from the Ministry of Defence.

8. Agriculture and Crofting

Arable farming

Until the time of the army takeover, changes of ownership probably made little real difference to those who actually lived at Barry Buddon. By the 16th century, there were a number of crofts in the northern part of Barry Buddon (see 'History and Land Tenure' above). 18th century maps indicate that, on the fringes of the more established farms was a heathy wasteland, plots of which were perhaps let at low rent to anyone willing to put in work improving them. But Bailie's (1826) plan shows a more formal system being imposed, and by the time of Horne's (1842) plan, the untidy scattering of buildings had been largely replaced by a planned landscape of rectilinear fields. In 1858-59, five years after Barry Buddon was brought into single ownership of Panmure Estate, the major tenant was John Collier, who held the farm of Buddon and Deyhouse with a rental value of £330, and Cowbyres, with a rental value of £70. However, Cowbyres and Deyhouse had over 30 sub-tenants, only one of whom paid more than £20, and ten of whom paid under £4 annual rent (Commissioners of Supply, 1859). Rental values did not rise significantly for the remainder of the 19th century. There were still minor tenants when the War Department purchased the land, and even as late as 1892, half-a-dozen tenants paid as little as 10 shillings (50 p) (Forfar County Council, 1892). While some of these tenancies may have applied to

dwellings only, without land, or conversely to small plots of land without attached buildings, the low rent values suggest real poverty amongst at least some residents of Barry Buddon. There are earlier records of some inhabitants of the Links receiving parish Poor Relief.

It is likely that the crofters' living from their fields and livestock was supplemented by shore fishing and beachcombing. Fuel was driftwood, gorse (furze), and perhaps locally-dug peat. The fields were divided by turf 'feal dykes', sometimes topped by gorse hedges or dead branches - Blackadder (1826) mapped several 'whin fences', and a number of turf dykes can still be traced after more than a century of abandonment (good examples survive to the north-east of the Grenade Range). The fields were perhaps fertilised with 'Bell Rock tangle', seaweed collected from the beach, a practice recorded in the county by Edward (1678b) - although seaweed does not get washed up in large quantities on Barry Sands today. As well as providing nutrients, seaweed would act as a sand-binder, counteracting the effects of windblow. In later times, the lighthouse-keeper's sunken garden was maintained in the same way, and turf dykes are clearly visible to the east of the Low Lighthouse cottage. The crofter's living was unreliable. While Smith (1905) noted that "crops of oats, rye, carrots and potatoes grew well", Warden (1881, p.401) reported that "...from the nature of the soil the crops are precarious, a dry season being disastrous to the cultivator." Unpredictable, often poor, harvests and primitive houses would explain the low rents payable.

General Roy's (1747-55) map shows only a few fields between Barry and Cowbyres on an otherwise featureless Barry Links, but it is known that Roy's military maps focused on features likely to be of strategic importance, and were merely illustrative in showing the presence of cultivation, "rather...a magnificent military sketch, than a very accurate map of a county" (Roy, 1785). Nevertheless, it would seem that there was only a small amount of arable land on the links in the late 18th century. Sim's (1791-99) "thirsty down" was "interspersed with some acres of arable land, which in showery seasons, yield a moderate crop of grain". Yet only 30 years later, Blackadder (1826) mapped around one-third of the area as arable. Cultivation continued to spread southwards from Barry until at least the 1850s; Gardiner (1848) feared the loss of Buddon's botanical treasures: "cultivation is gradually extending southwards over this sandy tract, and probably, in a few years, fields and gardens will occupy the place...". Fortunately for botanists, most of the Links remained uncultivated. Despite Chalmers' (1803) assertion that "the surface above these links is rugged; but, upon the whole, tolerably fertile, and almost certainly arable", the thin soils of the sandy links could, as observed in the *New Statistical Account*, "hardly be improved" (Miller, 1845). This must have been particularly true of Deyhouse farm on the east coast of Barry Buddon, which comprised 308 acres pasture, 91 acres outfield, 193 acres "benty hillocks", and 561 acres "sand and sandy hills" (Holden, 1767b);

figures which concur with Ainslie's (1775) map showing almost the whole eastern portion as unvegetated sandhills. Yet Deyhouse had formed part of the landholdings feued to Robert Forrester in the 1550s, when it was presumably considered to be of significant economic value - it can be speculated that it was amongst the farmland overwhelmed by drifting sand in the early 17th century as the dunes moved eastwards across the links (see 'Geology, Soils and Geomorphology' above).

Miller's (1845) assessment was confirmed by the Soil Survey over a century later, which mapped the whole seaward half of Barry Buddon as Class 7 dune sand, unsuitable even for permanent grass, on account of its low moisture-holding capacity and susceptibility to wind erosion. Even the northern half, much of which had formerly been cultivated, was mapped as Class 6, restricting its potential agricultural use to rough grazing (Laing, 1976). Even the largest landholdings on such poor ground cannot have been particularly profitable; photographs of Buddon Farm (the main farm in the western part of Barry Buddon) taken probably in the 1860s (ahead of the general agricultural depression of the 1870s) show the buildings apparently in a badly run-down condition, and Andrew Tocher, the tenant and farm overseer in 1861, later took employment as a labourer with the railway company (Pugh, 2003).

Woolven (1987) states that cultivation ceased when the War Department acquired the land in 1892, but in fact the process was more gradual. The county valuation rolls for the next few years show a diminishing number of sub-tenants on the Cowbyres and Deyhouse lands as existing tenancy agreements came to an end, or as tenants accepted payment from the War Department to vacate their land. Provision had been made to compensate tenants for inexhausted manures or other improvements. The steadings of Cowbyres and Deyhouse themselves continued to be worked until 1904. Cowbyres farmhouse had been rebuilt only a few years before the War Department takeover (the lintel is engraved "JD 1887 ED"[25]), and was later to house the Camp Commandant. The last farm tenant at Cowbyres was James Gibson, and at Deyhouse, Alexander Donald, both of whom had been tenants before the War Department bought the land. Certainly, acquisition by the War Department in the early 1890s stopped any further attempts to expand arable farming, but this may simply have accelerated a contraction of cultivation from what was very marginal land.

A War Department plan drawn as early as 1891 showing land use (reproduced in Woolven, 1987) shows arable land already restricted to the central northern portion near Cowbyres, with a considerably larger extent of "pasture ploughed sometimes" and "arable pasture" - presumably former arable land - to the south and west. By 1905 the farms had "mostly been laid down in grass" (Smith, 1905). Photographs of the army camps taken around this time show a large extent of short turf, in places showing obvious signs of having been mown.

Croft houses

Like the field dykes, the original houses were built of turf, with only a few timbers of driftwood to support the roof, also of turf and thatch. The floor was of soil, or clay where available. The only stones traditionally used were a few 'chucky stones' from the beach to line the central hearth, although later, when imported stone or brick became available, some houses might have a gable-end fireplace and chimney[26]. By the end of the 18th century the *Old Statistical Account* referred to "the turf-built cottages of former days..." in the past tense (Sim, 1791-99), but it would seem that the minister of Barry was downplaying the poor living conditions of some of his parishioners.

It may be that by this time, some of the poorest crofts had been abandoned in the wake of new agricultural methods which enabled the development of fewer, larger, more prosperous, farms in the northern part of the links[27]. Similar depopulation is recorded at Tentsmuir when larger farms developed in the years up to the 1830s (Watson, 1845). Yet nearly a century after the *Old Statistical Account*, Warden (1880, p.100) used the present tense when he wrote "The northern portion of the links have long been cultivated by pendiclers, who live in primitive houses, mostly constructed of turf with thatched roofs, and in favourable seasons fair crops of oats, barley, turnips, & c. are raised on the sandy soil". Elsewhere, Warden (1884, p.835) thought these huts "hardly deserve the name of houses". Despite Sim's (1791-99) attempt to consign them to the past, such dwellings would not have been unusual at the time of the *Old Statistical Account*: buildings made from alternating layers of stone and turf were widespread in Scotland at the time (Fenton, 1968), and Headrick (1813) reported that this was the most common building material in Angus. Where there was no stone, it would be natural to use turf alone. Houses of similar design and construction were inhabited on Tentsmuir until the 19th century (Hutcheson, 1914); except for the addition of a chimney, their design would have scarcely changed since medieval times[28]. However, by the second half of the 19th century, the continued occupation of such primitive huts, as is recorded at Barry Buddon, probably was exceptional, though not unique in Scotland (Walker, 1979).

Many turf huts still dotted Barry Links as late as the 1870s, and Hutcheson (1927) gives a detailed description of them and their method of construction, adding that they usually took about one week to build, at a cost of 6d (2½p). The best turf for building was thick, well-matted turf from the best pasture, that had never been ploughed, involving the destruction of much good pasture (Hutcheson, 1927; Walker, 1979). Construction of even a small hut would require the stripping of perhaps 50-100 m^2 of turf; indeed Ross (1992) quotes a figure of almost exactly one acre of ground to produce walling material, and a further 200 square yards for the roof – a total of more than 0.42 ha for a not particularly large building. Such buildings had only short lifespans, the roof in particular needing to be replaced at two-yearly

intervals, involving a considerable investment of labour as well as turf. If the old sods and thatch were thrown onto the midden and mixed with dung, the waste material would serve as a soil improver; however dry turf is very flammable, and it is likely that poorer inhabitants with no long-term stake in their holdings would be tempted to use it for fuel. In this case it is easy to see how the method of building would not only cause short-term devastation of pastureland, but might cause long-term impoverishment of the already infertile soils and contribute to the instability of the dunes.

Around and between the crofts, quite a scattering of unnamed buildings are shown on the maps by Ainslie (1794) and Blackadder (1826). Several steadings which survived well into the 19th century - 'Cowbayrs', 'Deuhous', 'Loghte' - can be traced back to the early 18th century (Marr, 1734), and even earlier: the monastic documents of the mid-16th century (see 'History and Land Tenure' above) record Bowman's (also known as Barrow), Buddon, Corsefauld (or 'Croecefaulds'), Cowbyre, Ryefaulds (or Ryfaulds), 'Saltgirse' or 'Saltgrass' (also known as 'Shepherd's Lands' or 'Shipstands'). The latter croft was near the sea, hence its names.

Livestock farming

The uncultivated parts of Barry Buddon supported grazing livestock. The earliest mention of any form of agriculture relates to the Abbey of Balmerino - it is said that the monks paid great attention to the rearing of horses, and erected stables on the links (Campbell, 1899). A piece of land near Deyhouse called Abbot's Horseward may have been used for this purpose, or it may merely have been an enclosure for keeping the Abbot's horse when he visited or hunted at Barry.

Warden (1881) claims that when Alexander III held court at Forfar around 1263, the Royal table was supplied with sheep from Barry Links. However, in later years, various observers noted that the Links were too dry to provide rich pasture - perhaps reflecting changes in climate, the spread of blowing sand, or the conversion of better soils to cultivation, pushing livestock onto more marginal land. Sim (1791-99) wrote that "the lower division [of Barry Parish] is composed of a thirsty down, which barely suffices for the grazing of a few flocks of sheep and young cattle"; there were perhaps 1,000 sheep in the entire parish. Chalmers (1803) said of Barry Parish that "the low ground of the banks of the river [Tay] is sandy, and affording only a scanty pasture to a few flocks of sheep"; Headrick (1813, p.445) recorded that about 1,000 sheep were kept upon the sands of Barry, but that "pasture and shelter are scanty…in all probability a stock of rabbits would be more profitable in that situation". Blackadder (1826) mapped the majority of Barry Buddon, including the whole southern portion, as either dry or damp pasture, while Horne (1842) marked a 'shepherds house' on top

of one of the dunes some 800 m north-east of the ice-house. Lumsden (1845) noted that much of the uncultivated ground in Barry Parish was "useful for pasture". Strangely, in neighbouring Monifieth Parish at that time, Miller (1845) wrote that sheep husbandry was "almost unknown". Though Warden (1881) wrote that "parts of the links afford good pasturage for cattle" (p.100), later in the same volume he describes it as "scanty herbage for a few cattle and sheep" (p.401). By the late 19th century, the recommendations of Don (1813) and Headrick (1813) had been heeded, and the uncultivated land was put to use as "a huge rabbit warren, from the capture of which the proprietor, the Earl of Dalhousie, derives a considerable sum yearly" (Warden, 1881, p.401). In fact, its value fluctuated. In 1886-87 the warren was valued at only £10, yet in 1892-93 the War Department let it to John McPhail[29] for £200 (Forfar County Council, 1893).

The pasturing of sheep continued in the 20th century under army ownership, although before the MoD land was fenced, the animals often strayed to the richer pastures of Carnoustie Golf Courses and Monifieth playing fields. At the time of Woolven's (1987) study, a grazing tenancy permitted up to 1,000 sheep from 1 October - 31 March - a density of just under 1/ha across the whole site, and the same number as recorded by Headrick (1813). Although free-ranging, the animals were of course not evenly dispersed, most grazing being concentrated to the north of the Camp Road, near Buddon Camp, and on Monifieth Links (Woolven, 1987). Later, the sheep were considered to spend most of their time grazing the relatively lush grass on the firing ranges (SNH, 2005). In the 1980s, grazing was reduced and eventually ceased because of the nuisance caused by the animals to army training. After a few years without grazing, sheep were reintroduced in the 1990s, but as their presence again interfered with the more intensive use of the ground for army exercises, they were again removed. For conservation management purposes, the links are now grazed by nearly 40 Highland cattle, in the care of Strathmore Farming Co. However, these are not free-ranging, being restricted to fenced areas in the northern part of the site, principally a 80-ha enclosure which includes the major part of Big Wood. The fences were erected during 2002, and the cattle were introduced in May/June 2004. If successful, cattle enclosures could be extended to cover a larger area of the links in future (Anon., 2004b). The new enclosures mean that Barry Buddon is more divided up by fences than at any time since the crofters left more than a century ago.

9. Fishing

Until the late 18th century, salmon fishing was traditionally undertaken using coble boats launched from the shore. By the end of the century, these were superseded by fixed stake-nets on the shore - an advance which coincided with the new development of transporting fresh salmon to London and other cities packed in ice. Stake-nets quickly became the main method of salmon fishing along the coast,

although after the 1830s, as an early conservation measure, within firths and estuaries only coble-netting was permitted. In the late 18th century, the rents of the salmon fishings in Monifieth Parish were £130 per annum (Roger, 1791-99), with much of the catch being sent to London even at that time. A few years later, the Panmure fishings alone fetched a rent of £1,500 a year - the location at the mouth of the Firth made them particularly valuable, with the advantage of being clear of competition from adjacent nets (Headrick, 1813). Farther into the estuary, migrating fish had to negotiate a series of stake-nets, one after another, stretching across the intertidal area (Bell, 1836). Blackadder (1826) mapped nine fishing reaches around the coast of Barry Buddon, giving the method at each. From east to west, they are: Johnny's Burn (stake net); Turrety Home (stake net); Waterloo (stake net); Lake (coble); Bold Attempt (net); Mid Shot (coble); Lighthouse (stake net); West Shot (coble); Buddon (coble). In 1825, rents in Monifieth parish reached £1,500, with a record of as many as 729 salmon being caught on one tide at one fishing-station; but by 1842 such a number could "hardly be got at one station during the whole season" and the rents had fallen to £325 (Miller, 1845). However, by 1858-59 Monifieth's salmon fishings were again valued at over £1,000. In Barry Parish in 1843, five fishing-stations were held by three proprietors (Lumsden, 1845); presumably some of the stations shown by Blackadder (1826) had been abandoned or amalgamated by this time.

The fishing rights continued to be let by the War Department after it acquired them in 1893. From 1927 they were let to the Tay Salmon Fisheries Company for a rent of £150 per year, which remained unchanged until 1971. The TSFC also rented all the adjacent Panmure Estates salmon-fishing rights extending north-east from the MoD boundary at Carnoustie, and purchased them outright in 1971 for £10,000. At first the Barry Buddon fishings just paid their way, and they suffered comparatively little interference from army training. However, in the 1930s, firing increasingly encroached into the early part of the fishing season; furthermore, a channel near Buddon Ness that had led fish back towards the stake-nets silted up. Fishing was abandoned in 1939. By the early 1950s, a serious decline in the Tay salmon stock was noticed, attributable to the construction of hydro-electric dams in the upper reaches. Despite these difficulties, TSFC continued to hold, but not work, the fishing rights to assist with policing against poaching and to enable control of the wider Tay salmon fisheries, providing a sanctuary through which the fish migrated to the benefit of the Tay's salmon stocks and river catch. By the late 1970s the company no longer felt it necessary to rent the fishings to help maintain law and order, and the tenancy from MoD was relinquished in 1980.

A number of salmon bothies once stood along the coastline, all long since lost to erosion or engulfed by sand. Most were probably no more than simple huts, but west of Buddon Ness, not far from the High Lighthouse, David Hunter of Pitskelly built a stone house in the 1820s, which later became a salmon bothy. No trace of the house

remains, but close to its former site, the ruin of an ice-house used for storing the catch is hidden in the dunes. It is shown on Horne's (1842) plan, but not on Blackadder's (1826) plan, so it was presumably also built by Hunter between these dates. The ice-house had a soil-covered barrel-vaulted roof and sunken porch containing a double doorway; the roof survived intact into the 20th century, but caved in many years ago, and continues to crumble. The entrance faces ENE rather than due north away from the sun, as might be expected; after around 1800 it was often thought more efficient to have the entrance to ice-houses facing east or even south-east, so that the early-morning sun could burn off damp air - believed more injurious to the stored ice than warmth. Drainage of meltwater was presumably simply by percolation into the sandy soil.

It would appear from contemporary maps that the Panmure fishings never had an ice-house, although they covered most of the coastline. The Buddon ice-house was on the Pitskelly Estate, which although its Cowbyres lands exceeded 1,330 acres (538 ha), had a coastal frontage of less than 450 m, with just a single fishing station. This may account for its small size, with a floor area of less than 17 m^2 despite a prime location at the mouth of one of Scotland's greatest salmon rivers. Perhaps if Barry Buddon's fishing rights had been in single ownership from an earlier date its size might have been comparable with coastal ice-houses elsewhere, for example the great ice-house built at Tentsmuir in 1888[30]. It is not known how the catch was exported to London before the coming of the railway or steamships, but it was often the case that in the early part of the season, while the weather was cold, fish were shipped to London raw, in the hope that a favourable wind would carry the ship there while the cargo remained reasonably fresh; later in the season, salmon might be kitted (parboiled and packed in vinegar) or salted for export - activities that would probably be carried out in the nearby villages rather than at the fishing-station (Haldane, 1981; Robertson, 1998).

Salmon-fishing was primarily a means of generating income, and the catch was too valuable to be eaten by most local people; for local consumption, Flounders *Platichthys flesus* could be caught by line from the shore. Miller (1845) records that Common Whelks *Buccinum undatum* (called 'Drumley buckies', after one of the sandbanks) were fished at the mouth of the Tay, mainly for bait. Not all 'fishing' activity may have been entirely innocent; until about 1820, smugglers used this coast, contraband being buried in the dunes until it could be recovered (Simpson, 1888).

10. Army

Defence

Barry Buddon, with its position guarding the mouth of the Tay, is not without strategic importance. It is said that in 1651, when the Cromwellian fleet anchored in

the Firth while laying siege to Dundee, cannons were brought to the Links from the city by the local militia and used to bombard the ships. The tactic was initially successful, causing the ships to lay off, but indecision on the part of the defenders allowed a counter-attack, and eventually the cannons were captured by the attackers (Markie, 2002).

A heavy cannonball found near Spion Kop Road in 1995, now preserved in the Officers' Mess at Buddon Camp, probably dates from this engagement. After Cromwell's time, three centuries were to pass before Barry Buddon was again disturbed by gunfire.

Throughout the 19th century, Britain went through a succession of periods when there was fear of invasion from France; these invasion panics were to shape Barry Buddon's future. In 1860, to defend Dundee, the 14th century Broughty Castle had been "transformed into a solid piece of modern masonry bristling all over with guns". In 1882 an unprotected battery (the Panmure Battery) was constructed, commanding the narrow entrance channel into the Tay. By the mid-1880s it had six 40-pounder Armstrong guns and had been promised four 32-pounder smooth-bore guns and four 7 ins. breech-loading guns[31] (Mudie *et al.*, 1970). Further research is needed to identify the site of the Panmure Battery, but a likely location was Monifieth Links - according to Gibson, heavy artillery on Monifieth Heights and Riverside Park had to be moved to protect the foundations of Monifieth's gas tank.

Grant (1888) did not consider the Tay's defences sufficient, but in advocating the further emplacement of modern guns, dismissed Buddon Ness as a location for a battery, since guns placed at the mouth of the Tay would be ineffective against any vessel that succeeded in running past them into the Firth. Despite these concerns, around 1903 a new unprotected battery was constructed at Buddon; it is likely that this was south of Buddon Camp, where the foundations of a battery of at least 11 heavy guns can still be seen. Some of these foundations appear to have been left uncompleted, and certainly the battery did not remain for long after World War I: as early as 1922, it was mapped as a dismantled battery (OS, 1922).

Like other low-lying coastlines that could make good enemy landing-grounds, Barry Buddon was also defended during World War II[32]. The area was defended by gun emplacements, concrete anti-tank blocks and minefields. Wooden anti-landing poles were set in the sands below high-tide line to prevent enemy aircraft from landing. Some of the defensive structures survive, but others have since been lost to coastal erosion, while many of the concrete anti-tank blocks near Carnoustie were moved in the 1970s and reused in an attempt to restrict the meandering of the Barry Burn. Despite its role in wartime, Barry Buddon's greatest military value has been as an army training ground.

Military training

An extensive level area, of marginal agricultural value, with few habitations, good road and rail links, largely isolated by water and a railway, and with potential for live firing towards the sea, was naturally suited for military training. From 1853, the landowner of the whole of Barry Buddon was Fox Maule Ramsay (1801-1874), 2nd Baron Panmure, who was Secretary for War during most of the Crimean War, the Indian Mutiny and several of the British Empire's other conflicts. The late 1850s were a time of heightened fear of invasion from France, and Maule saw the need for well-trained volunteer regiments. A War Office circular published in 1859 drew on the Georgian Yeomanry and Volunteer Consolidation Act, formalising ad hoc volunteer groups already in existence around the country, and paved the way for county volunteer corps. Maule gave permission for the use of his own land for artillery and rifle practice, and soon the area was being used for training by the Forfarshire Artillery Volunteers (formed in December 1860 by the amalgamation of several local corps) and the Forfarshire Rifle Volunteers. Such use was fairly intensive: by 1862 the two regiments totalled about 1,100 men, and the 1st Forfarshire Rifle Volunteers had rifle practice at Monifieth West Range all day Saturdays and on Monday afternoons, in addition to twice-weekly drill in Dundee, and other exercises (Nicoll, 1993). The 1st Forfarshire Rifle Volunteers first camp at Barry Buddon was held in June 1868, and became an annual event thereafter. Artillery practice at first took place to the east of Broughty Castle, but field artillery were used at Barry Buddon, and from the 1880s training on fixed artillery transferred to the Panmure Battery. Barry Buddon hosted a Grand Review in 1865, and for some years afterwards annual competitions of Artillery Volunteers from the whole of eastern and central Scotland took place there (Warden, 1881). Naval volunteers also used the area: in 1865, a battery in the form of a wooden structure representing a section of a man o' war was erected near the mouth of the Barry Burn at Carnoustie for the training of the Royal Navy Reserve (Dickson, 1892); activity that local newspapers reported "somewhat interferes with golf"[33].

In the early 1880s, with renewed fears of French aggression, a campaign to establish a permanent school of gunnery at Barry Buddon gathered pace, led by Fox Maule Ramsay's successor, the 13th Earl of Dalhousie, and supported by local MPs. In September 1885, the War Office approved the area as a "permanent camp for artillery instruction", a decision confirmed in February 1886 despite protests from volunteer regiments in the west of Scotland (who favoured a site near Irvine, Ayrshire). The deciding factor was "in consequence of having determined to provide defensive works for the Tay". Although the gun emplacements at Broughty Castle and the later batteries guarding the Tay never saw active service, they had ensured Barry Buddon's future as a military training ground. Soon afterwards, in 1887, the 13th Earl of Dalhousie died, and anxious to secure what was regarded as the best training-ground

in Scotland, the War Department bought almost the whole of Barry Buddon, together with 1 km-long stretch of Monifieth Links, and some land to the north of the railway, in 1891-93. Only the north-eastern corner, which was purchased by the Borough of Carnoustie and is now occupied by the town's golf courses, remained outside army ownership.

With the permanent army takeover, the farmers and crofters had to go, their occupation dwindling over a number of years as leases expired, or as compensation was accepted. Local people objected to the 'red flag' restrictions on access and disturbance caused by gunfire. No longer was it possible for the traveller on the links to "wander at his own sweet will" (Simpson, 1888). The loss of freedom of access was compounded in 1914, when an alliance of Monifieth Town Council, the Links Committee, the War Department and the railway company closed a right of way across Monifieth Links to the south of Well Street. As late as the 1930s, holidaymakers were prosecuted for trying to follow this former short-cut (Anon., 1933).

The training ground had an impact far beyond Barry Buddon itself – the large numbers of trainees made the War Department a major buyer of potatoes, which were much cultivated in the area. Army horses also required fodder, and were boarded during the winter months with farmers all over Angus[34] (Thompson, 1998). Horses continued to be used well into the 20th century – not until 1926 did the army experiment using agricultural tractors for hauling heavy guns[35].

There were two army camps, both on the level plain in the northern part of Barry Buddon. Barry Camp was near the level-crossing from Barry, while Buddon Camp lay some 2 km farther west towards Monifieth. By the early years of the 20th century, each camp was equivalent almost to a small town in terms of size, housing many hundreds of men and large numbers of horses for a period of several months every year. In addition to full-time soldiers and volunteers, Barry Camp accommodated the sons of servicemen from Queen Victoria School, Dunblane, during their summer break (Dowling, 1990). Despite this intensive use, the direct impact on the ecology of the immediate area would have been more limited than might be supposed, because prior to the army takeover, the land occupied by the camps had mainly been used for agriculture.

Initially the camps were just that - tented encampments, with the men living under canvas in bell-tents, and with communal facilities in marquees and temporary wooden sheds. Contemporary photographs show that sleeping accommodation remained tented until at least the 1920s. In stormy weather, such as during May 1913, the troops had to endure tents that were flooded or flattened. Work on an officers'

mess began in 1893 (Dick, Peddie and McKay, 1893-95), but the first major permanent building for the troops was the corrugated iron 'Soldiers' Home', one of several founded by Miss Williamina Davidson, a Sister of the Order of St John of Jerusalem. It provided off-duty refreshments, recreation and concert entertainments (some of which were also attended by local residents), and soon had to be extended to cope with the influx of recruits during World War I. Local people donated books and other items for the home, and in August 1934, supported a fund-raising concert to raise money for much-needed repairs. The Home was eventually closed around the late 1960s (Gillon, 1977)[36]. By World War II, many permanent sheds and corrugated-iron Nissen huts had been built, although tents may still have been used for 'overflow' accommodation. Once army use of the area became permanent, Barry Station was soon extended to accommodate the extra traffic, and in 1919 was renamed Barry Links Station; a separate siding for Buddon Camp was opened in 1910 (Butt, 1995). The railway was the main means by which the troops arrived, and the platform at Barry was of an extraordinary length for a small rural station, extending well beyond the part still in use today.

Not all the men enjoyed their time at the camps; in July 1911 a Clydeside volunteer wrote home from Buddon Camp "...about 70 men are going home next Sat, they are fed up"; more recently, a sentry felt moved to leave the graffiti on the isolated flagpole at Buddon Ness "God! What an awful place!" (Anon., 1983b). And there were occasional casualties - the 1913 season was particularly tragic, beginning with three Cameron Highlanders being blown up when they disturbed an unexploded shell, and ending with a young Territorial being terribly injured when he was trampled under a stampede of horses.

In the early years of the 20th century, postcards of the camps were produced by several publishers, and sold to soldiers to send to their families, or to the public who came to spectate at military reviews. More than two dozen different postcards are known; these contain a fascinating record of activities at the training camps. In addition to a wooden pillar-box, the Camps had their own post office from the early 1900s until at least the 1950s, in an outbuilding attached to a farmhouse just north of Barry Station (Thompson, 1998), with a separate postal facility at Buddon Camp until at least the end of World War I; the postmarks 'Barry Camp' and 'Buddon Camp' are today sought-after by collectors.

Buddon Camp eventually supplanted Barry Camp, which was dismantled by the 1970s (Milne, 1976). Following major investment in new buildings during the 1990s, Buddon Camp was renamed Barry Buddon Camp, and is described as 'the jewel in the crown' of Scotland's Army Training Estate (ATE, 2000). As the largest army training ground in Scotland, it is intensively used, even more so since defence cutbacks in the 1980s closed some ranges elsewhere, and since the more recent loss of training areas in Germany[37]. The camp has accommodation for over 500

Plate 1

A Valentines postcard of Barry Camp, looking east towards Carnoustie, showing the scale of the camps in the 1900s. This example from the author's collection is postmarked 1910.

personnel, and about 30,000 personnel pass through annually from all three armed services, cadets and some civilian organisations. It is the headquarters of the Angus and Dundee Battalion of the Army Cadet Force, and the weekend training centre for the Monifieth Black Watch Detachment. In addition to cadets and the Territorial Army, Barry Buddon also provides training facilities for other units, including Royal Marines based at nearby RM Condor, Arbroath.

Barry Buddon has 22 firing ranges including one of the few full-length firing ranges remaining in Scotland, so is heavily used for small arms training. There are grenade and mortar ranges, and heavier weapons can still be fired toward the Sandy Downs. Woolven (1987) attempted to relate levels and types of usage to effects on the nature conservation interest, but there is no simple linear relationship, and in any case there have been major changes in patterns of use of the site since the 1980s. Since 2003, support services at Barry Buddon, as at other Defence Estates, have been managed by Landmarc under a public-private partnership contract, while the Army Training Estate concentrates on training activities.

11. Sport

Racing

The Monifieth Races were held at Buddon from at least as early as June 1797 until about 1830, and were revived from 1839-1841 (Malcolm, 1910). Although the origins are obscure, it was not a traditional event, and was probably started by William Maule, later Lord Panmure; two winner's cups were presented by Maule in 1797 and 1798[38]. The main event took place annually usually in July or August, but spring and autumn fixtures were also held in some years. In 1839 as many as 30,000 people attended, arriving by boat as well as by the newly-opened railway. A contemporary newspaper report gives the impression somewhat of a country fair, including races for farm horses, carthorses and pigs! The racecourse lay on the level plain to the east of the present Buddon Camp; the stables are shown on Bailie's (1826) plan, and were later incorporated into Buddon Farm, remaining in use at Buddon Camp as an army store and camp caretaker's house until the 1980s (Ellwood, 1982b). By the 1820s, the area to the east and south-east of the stables was being converted to farmland, and the enclosure of much of the most level land may have been a factor in the decline of the races. In the 1930s, almost a century after horse-racing ended, the sandflats of Monifieth Sands served as a venue for motor-racing and motorcycle-racing (activities soon discontinued following a fatal accident).

Golf

Horseracing was not the first sporting activity at Barry Buddon; the links were used for archery, and in August 1628, the Marquis of Montrose lost 12 shillings in an

archery contest (Malcolm, 1910). The *Registrum de Panmure* tells that Robert Maule, Earl of Panmure (1497-1560) "exerciset the gowf, and oftymes past to Barry Lynkes, quhan the wadsie [stake] vos for drink. This was the zeir of God 1527, or thear abouts" (Maule, 1874). In 1643 Monifieth Kirk Session passed an Act barring "gowf on the Lord's Day". The chief offence lay not in playing golf, but in being absent from church services. Despite this prohibition, according to the records of Monifieth Kirk Session, in December 1689 Robert Morome and his partner were "ordeanit to be summondit for playing at the gowff befor noone in tyme of preachne".

The advent of proper golf courses on the north bank of the Tay followed the opening of Dundee to Arbroath railway in 1838, which here, as elsewhere, made the golf links accessible to a wider public (Nalder, 2000). Very early in its history, the railway offered special fares to golfers. The first courses were created at Carnoustie in 1839 (10 holes), and at Monifieth in 1845 (6 holes), on land leased from the Earl of Panmure, the Monifieth Club's patron – although, inconveniently for the golfers, James Maule of Monifieth Farm retained rights of pasturage over the latter course until his death in 1851 (Fraser, 1995; MacKenzie, 1999). In 1981, Carnoustie's Buddon Links Course was laid out in the north-eastern corner of Barry Buddon on land purchased from the MoD - each hole being named after a famous battle, as a tribute to the land's military heritage. Today there are three 18-hole courses at Carnoustie, and two at Monifieth, and together with the railway, they help to provide a buffer zone between Barry Buddon and other land-uses to the north. Fragments of dune habitat with relict flora still survive in places on the golf links, but Parkin's (1944) description that "many parts of the [golf] links are of a heath-like character" is no longer true today.

12. Transport

Roads

As an uninhabited foreland, Barry Buddon has remained free of public roads. The modern main A92 Dundee - Arbroath dual carriageway takes an inland route mainly along the line of the post-road constructed around the 1770s (Sim, 1791-99). The A930 Monifieth - Carnoustie road follows an older route north of the railway, safely above the damp areas and the floodplain of the Barry Burn. The western section towards Monifieth retains the twists and turns that it had when it was just an unsurfaced 'sandy roadie', but the Barry bypass (opened in 2005) has relegated the eastern section to a minor road, so most motorists are unaware how much the old route was shaped by topography and weather. Surprisingly, Edward's map of 1678 shows the main east coast road passing through Barry Buddon, south of Cowbyres, 'Deuhouse', and the now-drained loch south-west of Barry. Perhaps this was an error: it is hard to explain such a route through scarcely-inhabited country, given the proximity of unstable sand

dunes and the difficulty of crossing the muddy Buddon and Barry Burns close to their mouths. While Sim (1791-99) stated that "the roads of Barrie, though somewhat fatiguing, are at all seasons dry", he also noted that "a detailed account of the bridges would reflect no honour on the police of the district". Ainslie's (1794) map shows the road following roughly its present route, although the *Old Statistical Account* for Barry predicted that "no waggon-road can reasonably be expected in the parish sooner than the year 1793" (Sim, 1791-99). Today, Barry Buddon has several kilometres of army road surfaced with tarmac or ballast, and many more grassy or sandy tracks. At one time all the army roads were unsurfaced, with railway sleepers, metal tracks or gravel laid in particularly difficult stretches. Speed-humps are now necessary to enforce speed limits on army roads that, some years ago, were almost impassable to all but four-wheel-drive vehicles. While making parts of the site more accessible to vehicles, improvements to the roads may have reduced the area affected by army traffic by concentrating traffic onto a few key routes, and reducing the amount of compaction and braiding alongside the main tracks.

Railways

In contrast to the winding A930 road, the Dundee - Arbroath railway (opened in 1838) cuts across the level ground in a 6.5 km length of dead-straight track. Lord Panmure was chairman of the Dundee and Arbroath Railway Company, and two-thirds of the route passed over his land. This was feued to the railway company for a nominal rent of only £40 per year, mainly to provide compensation for tenants. It was said to have been the cheapest railway in Britain to build, although its costs did overrun (Miller, 1845; Marshall, 1996). Barry Station opened in 1851, and Buddon siding in 1910 (Butt, 1995). Despite Thomas Erskine's despair at the impact of the railway on the landscape "...the Jötun has practised a railroad through the heart of it, which has plucked out the heart of its mystery" (Hanna, 1877, p.15), it is likely that the barrier created by the railway helped to protect the links to its south from development.

Aircraft

In the 1920s, the sight of light aircraft using the level grassy plain near Buddon Camp as a landing strip must have aroused much interest, just as, in more recent times, did parachute training jumps from a barrage balloon tethered near the camp. A number of postcards of Barry Buddon dating from as early as World War I show low-flying aircraft, but these appear to have been inserted by photomontage to add interest to the scenes - the planes having been photographed elsewhere, most likely at Montrose Aerodrome. In the 1930s pleasure flights around Monifieth Bay could be had for five shillings (25 p), taking off from Monifieth Sands at low tide (Brotchie and Herd, 1980). A grass airstrip south-east of Buddon Camp was operational from

1966 to 1976 (Luck, n.d.) and is still maintained for parachute training. Despite an experiment in the 1980s at launching a hang-glider using an electric winch, the aircraft most likely to fly at Barry Buddon today are those from Dundee Model Aircraft Club, based there since the 1960s.

13. Lighthouses and Other Structures

Lighthouses

The treacherous Gaa and Abertay Sands, submerged at most states of the tide, have always been a hazard to shipping passing through the narrow channel into the Tay, and have been the site of many wrecks. Dangerous even in good visibility, the sands formed a virtual barrier to shipping during the hours of darkness. Although Geikie (1887) asserted that a light had been erected by the early 17th century, and Currie (1970, cited by Wright, 1981) put the date 100 years earlier, there is no record of any kind of beacon at such an early date[39]. The first depiction of lighthouses at Buddon Ness is in Collins' (1693) chart, surveyed by Marr. No lights are shown in Marr's earlier chart, surveyed around 1666, which shows Buddon Ness itself being used to provide a leading line (Laing, 2002); if a beacon of any sort had existed then, a mariner such as Marr would surely have shown it.

There is further written evidence that there was no light at all on the Tay prior to 1687, when the Fraternity of Masters and Seamen of Dundee (the Seamans' Fraternity), with the support of the Magistrates of Dundee, petitioned for a Warrant of Privy Council, to enable them to erect a light. Having been awarded their Warrant in February 1687, they applied to Lord Panmure for land to build it, explaining that the Tay "having ane narrow entry betwixt two dangerous banks so that it cannot be entered under night except by the best experienced seamen without imminent hazard, there being no assistance of lights or beacons, so that strangers ordinarily in stress are forced to run close ashore and lose all, and even the natives keep off to the outward bay with great danger, to the great prejudice and discouragement of trade and the ruin and loss of men's lives', all of which might be prevented by erecting a light or two at Buddon Ness" (Dalhousie Muniments, quoted in Munro, 1979). The Earl of Panmure willingly feued ground to the Seamans' Fraternity for the purpose, at a nominal annual ground rent of five shillings (25 p)[40]. A square sandstone boundary stone at the corner of the keeper's garden close to the present High Lighthouse bears the initials M for Maule (Panmure's family name), and SF for Seamans' Fraternity; a similar stone is buried in the dunes mid-way between the High and Low Lighthouses. It is likely that there were at least four of these stones originally. The boundary stones appear more recent than the 17th century, and are probably contemporary with a later generation of lighthouses, or possibly date from 1774 when the Fraternity was formally constituted by Royal Charter.

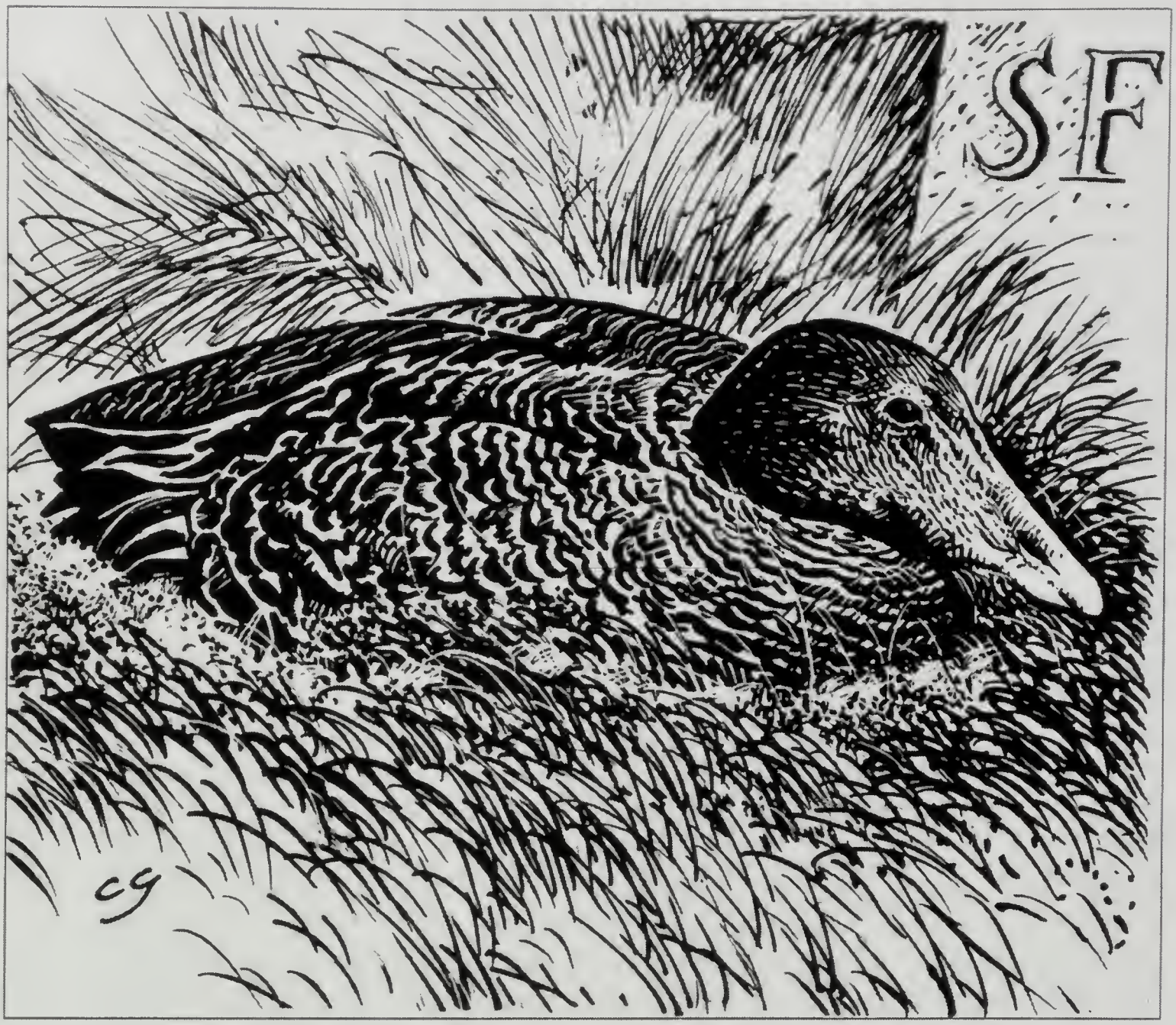

Figure 4

An Eider nesting beside the boundary stone marking the limit of land feued to the Seamans' Fraternity of Dundee. Illustration by Colin Gibson, drawn during the 1950s.

The first of several generations of permanent lighthouses was soon erected - the first recorded Scottish lighthouse, as opposed to a mere open beacon (NAS, n.d.). Construction was underway in October 1687, when £63.12.08 was spent, and was continuing in January 1688, when £95.09.10 was spent[41]. From the outset, the lights were not merely a beacon to mark a hazard, but a double or leading light. Incoming ships kept the two lights in line, to avoid the sandbanks. A chart of the east coast of Scotland surveyed around this date shows 'Bottannais' with two lights to guide mariners between the sands of 'Avertis' and 'Goa' (Marr, 1693; Collins, 1693); a later chart by the same surveyor distinguishes the more north-westerly 'great light' from the 'small light' nearer the headland (Marr, 1734). This first generation of lights was coal-fired, and the Seamans' Fraternity accounts show many payments for the purchase and shipping of 'coalls' to 'Butonnes' (oil was also sometimes purchased, perhaps to assist starting the fires)[42].

To fund the lighthouses, the Privy Council Warrant authorised the Seamans' Fraternity or their 'boxmasters' to collect dues of 12d Scots per ton on vessels entering or leaving a wide area outside the Firth, between Red Head and Fife Ness, foreigners paying a higher rate of 2s. From an early date, there was difficulty collecting this tax - in December 1691, the Fraternity petitioned the Privy Council to allow them to enforce payment, having been "at great expense thir several years bygone in keeping up ane advantageous light to there Majesties haille leidges". However, the Privy Council instead advised the Fraternity to pursue civil action against the debtors, calling on the courts to look favourably on such claims. In 1695, £182 Scots (£15 English) was collected (Munro, 1979), but inevitably resentment continued, and as late as 1849 (when a 60-ton schooner paid 6s9d), there were complaints that the charges were the highest in Scotland (Anon., n.d.). Complainants pointed out that "...from the great extension of the commerce and shipping of the port of Dundee, the revenue is greatly increased, while the expenditure for the light remains nearly the same" (DHT, 1847).

Whether due to coastal erosion, hasty construction or lack of funds, by 1711 the lighthouses were reported to be decaying, and the feasibility of replacing them with buoys was discussed. New lights were eventually constructed in 1753. The designers were well aware of the shifting nature of the channels, and wisely erected only one solid structure, described as "a circular stone building erected on piles" (Sim, 1791-99). Headrick (1813) described it as being about 60 feet (18 metres) high. A measured sketch of the 'North Lighthouse' by Holden (1767) shows the tower with a single-storey house attached, and gives the height of the stonework to the base of the lantern as 57 feet (17.4 m); the circumference at the top as 33 feet 5 inches (10.12 m); and the circumference at the bottom as 61 feet. (18.6 m). The lower light, several hundred

yards nearer the sea, consisted of a lantern mounted on a moveable wooden framework about 40 feet (12 metres) high, on rollers so that it could be moved when adjustment was needed. Blackadder's (1826) map shows a 'large' and a 'small' lighthouse' at Buddon Ness, with the "foundations of old lighthouse" - presumably the inner 1687 tower - on the shore just below HWMOT some 700 m to the SSW of the latter.

Munro (1979) speculates that the lanterns may have been candle-powered rather than coal-fired - a more effective means of lighting than it might sound, particularly when used with reflectors for leading lights as at Buddon (Pearson, 1995). Whichever fuel was used initially, there was an important development in 1789 when the Seamans' Fraternity purchased equipment for oil lamps from Thomas Smith (Munro, 1979). It is likely that these were Argand lamps, invented in 1784, which made oil lighting much more efficient and brighter than it had been previously (Pearson, 1995)[43]. The lighthouses were whitewashed, and were fitted with metallic reflectors (Headrick, 1813). Around 1832, leading lights were constructed at Tayport; these were picked up by ships after passing Buddon Ness, guiding vessels almost to Dundee.

Even with the lighthouses, the Tay remained a difficult entry to navigate. In 1838, deployment of a floating light was considered, but was opposed on grounds of cost; however, the mode of navigational lighting of the Tay continued to be debated for the next decade, and once again the use of buoys and a floating light was considered (Denham, 1847; DHT, 1847; Stevenson, 1847a, 1847b)[44]. While debate continued, changes to the lighthouses were limited to the painting of a black strip on the High Lighthouse to make it more visible against snow (Jeffrey, 1996). After a further 20 years, the question was again reviewed. This time the use of a lightship or a pile light on Abertay Sands was considered (DHT, 1866), but it was eventually decided to replace the 1753 lighthouses with what would be the final generation of Buddon lighthouses (CNL, 1867). The two existing detached brick-built towers, the Monifieth High and Low Lighthouses, were built by Messrs. William Anderson and Sons of Dundee for engineers D. and T. Stevenson in 1865-66, and fitted with the most advanced optics then available, manufactured by Messrs. Chance of Birmingham. The lights had a range of 16 and 14 miles (24 and 22.4 km) respectively.

It would appear that the Victorian two-storey lighthouse-keeper's house is on the site of the single-storey 18th century cottage depicted by Holden (1767), with the lower part of the earlier stone lighthouse (smaller in diameter than the present High Lighthouse) still attached to it. This structure was used as a storeroom by the last lighthouse-keeper. Although, according to the RCAHMS Canmore database, the earliest large-scale Ordnance Survey maps indicate that this is the base of the

previous lighthouse, it cannot be ruled out that this structure may be an unfinished tower, abandoned after the channels shifted faster than the masons could work. The RCAHMS describes how, internally, part of the spiral staircase survives, ending abruptly at the present roof level, and the original flagstone flooring is also *in situ*. However, the database goes on to make the suggestion that this structure is the original Buddon lighthouse, and dates both it and the cottage to around 1820 - the first of these statements is certainly incorrect, and the second seems doubtful. Further research is needed to elucidate the building's history[45].

Each tower had its own lighthouse keeper, with the keeper of the High Lighthouse being the more senior position; the keeper of the Low Lighthouse was given only a single-storey cottage, while the keeper of the High Lighthouse had a servant or housekeeper[46]. Under the Dundee Harbour Consolidation Act 1875, responsibility for the lighthouses was transferred to the Dundee Harbour Trustees, but throughout their history, the Tay lighthouses remained 'local lights', unlike the majority of Scottish lighthouses, which were public lights maintained by the Commissioners of Northern Lights.

Concerns that the navigational channel was insufficiently lighted remained; a wreck in 1873 was attributed to defective lighting and buoying of the river, and some local shipmasters even asserted that it had become "more difficult and dangerous to take the Tay in a dirty night" than 20 years previously. Consequently the Abertay Lightship was commissioned in 1876; in conjunction with the Buddon High Light, it provided a leading line avoiding the hazardous sandbanks.

Less than 20 years after they were built, the developing sandbanks and the gradual shifting of the channel threatened to make the lighthouses obsolete. Once again, a movable light, this time a skeleton iron tower on wheels, was proposed, but the rate of shifting of the channels was considered to be too slow to merit building such a structure. The Dundee Harbour Trustees adopted a novel solution to the problem. Under the charge of the Harbour Engineer, David Cunningham, and foreman carpenter David Law, the 447-tonne low light was cut at its base, jacked up and, hauled by traction engines, moved bodily on rollers along well-greased wooden rails to new foundations some 63 m to the north-east, where it still stands. This was probably the first time a masonry lighthouse had been relocated in one piece. The move explains why the ruins of the keeper's cottage, which would have been close to the original location, are some distance from the tower. Reports of a crowd of onlookers including the children of Barry School, granted a day's holiday to witness the historic event, give the impression that the move was a speedy one, but in fact the process took exactly one month, from 5 May until 4 June 1884 (Cunningham, 1885; Richou, 1885; Munro, 1979; McGlashan, 2003), and the children were probably

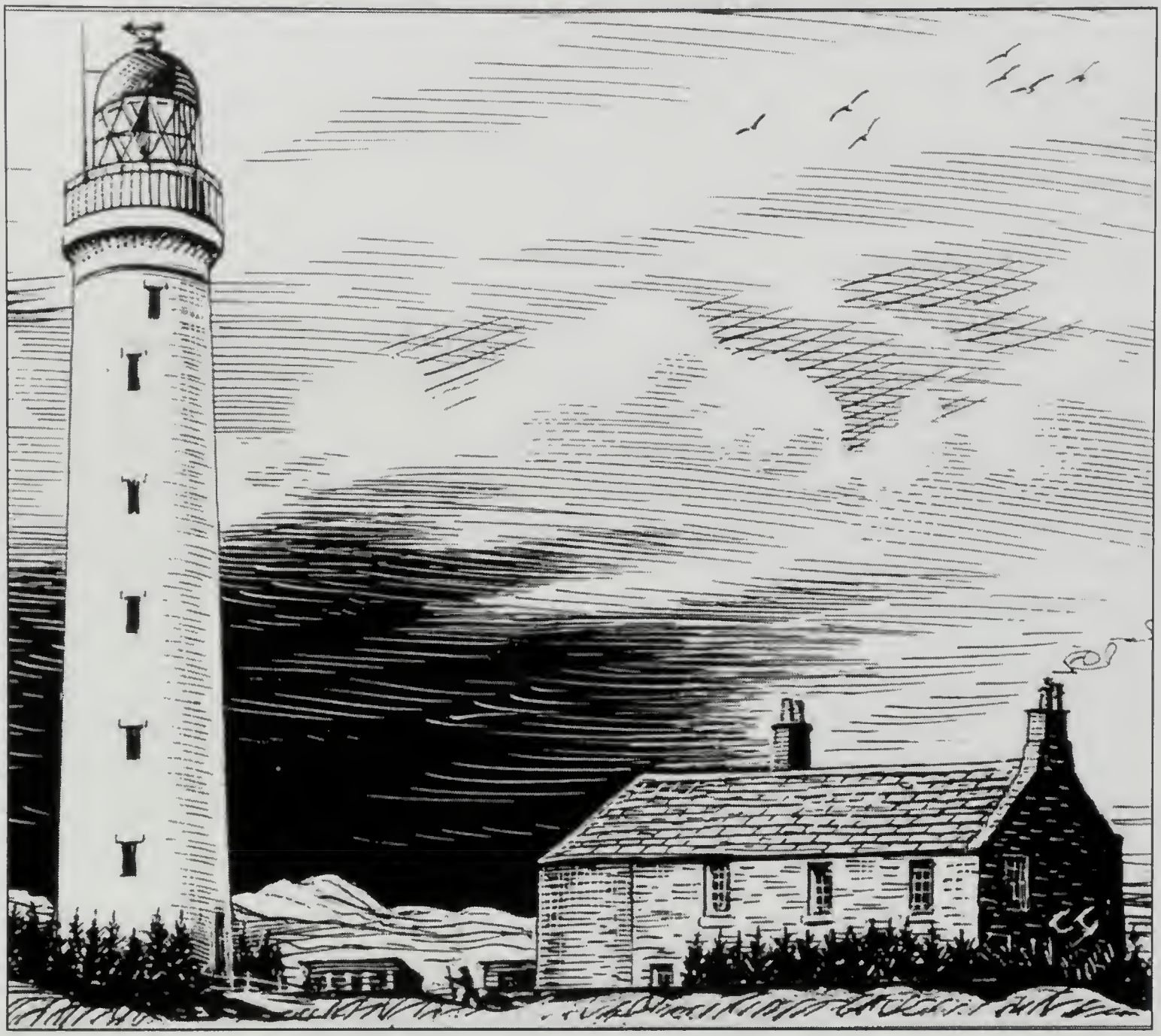

Figure 5

The present Buddon High Lighthouse and keeper's house while still occupied, showing the base of an earlier stone tower built into the end of the house, and a recently-planted conifer shelter-belt.
Illustration by Colin Gibson.

Figure 6

The Buddon Low Lighthouse viewed from the east, with the High Lighthouse in the background. Illustration by Colin Gibson.

bored by the lighthouse's speed of 2.5 cm per minute. The opportunity was taken to raise the height of the tower by 178 mm to improve clearance of the light above the dunes. Once completed, the Harbour Trustees sailed down the Tay in the yacht *Princess Louise* to inspect the work.

In the early 1940s the channel shifted again, this time assisted by dredging, and in 1943 both lights went out of commission for the last time, their duties taken over by the more mobile Abertay lightship (itself later replaced by a buoy and modern radar navigation). For a short time afterwards, a single light shone upstream to assist outgoing vessels, until superseded by a light at Broughty Castle. For a time it seems to have been thought that the channel might shift back again - the buildings continued to be owned by Dundee Port Authority[47], who retained the right of access across the MoD land, and the equipment was left in the lanterns and maintained in working order by the last keeper, Charles G. Liness, who continued to live at the keeper's house after retirement until old age forced him to move to Westhaven, after 46 years at Buddon[48]. The stone cottage that stands a short distance from the Low Lighthouse was abandoned and allowed to fall derelict after the lighthouses were decommissioned. Being close to the sea, finding a reliable fresh water supply may have been a problem here - the remains of several wells and a pump are visible in the garden, while Blackadder's (1826) map shows, in addition to a well beside the 'large lighthouse', two 'old wells' and at least three 'pits' to its north-east.

Following decommissioning, the High Lighthouse served as an army observation post. In the 1970s the Low Lighthouse door was bricked up (subsequently fitted with an armoured door), and the High Lighthouse and adjacent keeper's house securely fenced, after vandals broke in and smashed the reflectors. In 1987, Dundee University installed a radar scanner in the light chamber, linked to equipment elsewhere in the building, and all the glass panes were replaced with radar-transparent canvas panels. (The canvas did not last long, and today the light-chamber is open to the elements.) The purpose of the radar was not for navigation, but to carry out long-term monitoring of wave patterns (Boalch and McManus, 1989). The High Lighthouse still serves a navigational purpose, as there is now a radar beacon operated by Forth Ports PLC mounted on the building. Both towers are listed buildings, but appear to be in deteriorating condition.

Other structures

The boundary stones near the lighthouses are not the only marker stones to have been placed at Buddon Ness. The 'Chancellor's Stone' was erected in 1817 to settle a dispute between the Duke of Atholl and The Hon. William Maule of Panmure over where the Tay ended. In 1812, Atholl and other proprietors of riparian fishings on the

Tay had launched litigation at the Court of Session to require the removal of stake-nets within the Firth, claiming that such netting was illegal. The complaint was upheld, and the outcome was that a line indicating the limits to the placing of stake-nets was drawn on a map across the eastern end of the 'Drumlan Sands'[49], and two blocks of Kingoodie sandstone were erected to mark its ends. The southern one ('the Sea Stane') was not at Tentsmuir Point as might be expected, but in a field about 3 km from St Andrews. The northern one, the Chancellor's Stone, was at Buddon Ness, where it was later buried under windblown sand. Its site is probably now beneath the North Sea, but it is not impossible that erosion might someday reveal it buried under the dunes.

Blackadder's (1826) map shows other rows of boundary stones running north-south, marking the borders of the 'Cowbyres Lands' (Pitskelly Estate) and the 'Buddon Lands' and 'Deyhouse Lands' (Panmure Estate) to the west and east respectively, a feature also shown in Bailie's (1826) plan of Buddon. However, these were not sufficient to prevent disputes arising, for Horne's (1842) map shows "march stones placed by orders of the Court of Session". Similar march stones delineating fishings are found elsewhere along the local coast, for example at Tentsmuir and St Andrews (Candow, 1989), while the 1:10,560 OS map of Barry Buddon (surveyed 1964-65) shows several stones marking the parish boundary across Monifieth Links. At least two square granite blocks inscribed 'WD' (for War Department) are visible close to the railway to the north-east of Barry Buddon Camp.

A lost memorial was a wooden cross erected by Polish troops billeted at Buddon Camp during World War II, in memory of fallen comrades. Almost 6 m high, it stood on a low mound, and was decorated with seashells. The shells soon flaked off, while the cross itself rotted and fell after not many years. A more recent war memorial is likely to be longer-lasting - a stone with a bronze plaque surrounded by a circle of oak trees was planted in memory of 13 men of 45 Commando Group who gave their lives in the 1982 recapture of the Falkland Islands.

Soon after inheriting his estate in the early 1820s, David Hunter of Pitskelly built a house between the prominent sandhill of St Helena, and Buddon Ness, with the intention of establishing a village, but his plans came to nothing, and the house became a salmon fishing-bothy. No trace of it survives today[50], but it is shown on Horne's (1842) plan, just west of the ice-house, and it would appear to have been significantly larger than the ice-house, and certainly bigger and more elaborate than a 'fishers hut' shown a little farther east. The modern town of Carnoustie is said to have been founded in similar fashion when Thomas Louson, salmon fisherman, itinerant shipwright and sea fencible (responsible for watching the coast during the Napoleonic Wars) built a cottage there in 1797, but it is hard to see any reason why settlers would have been attracted to a remote location in the dunes near Buddon Ness. Hunter's reason for establishing a settlement was well-intentioned, if

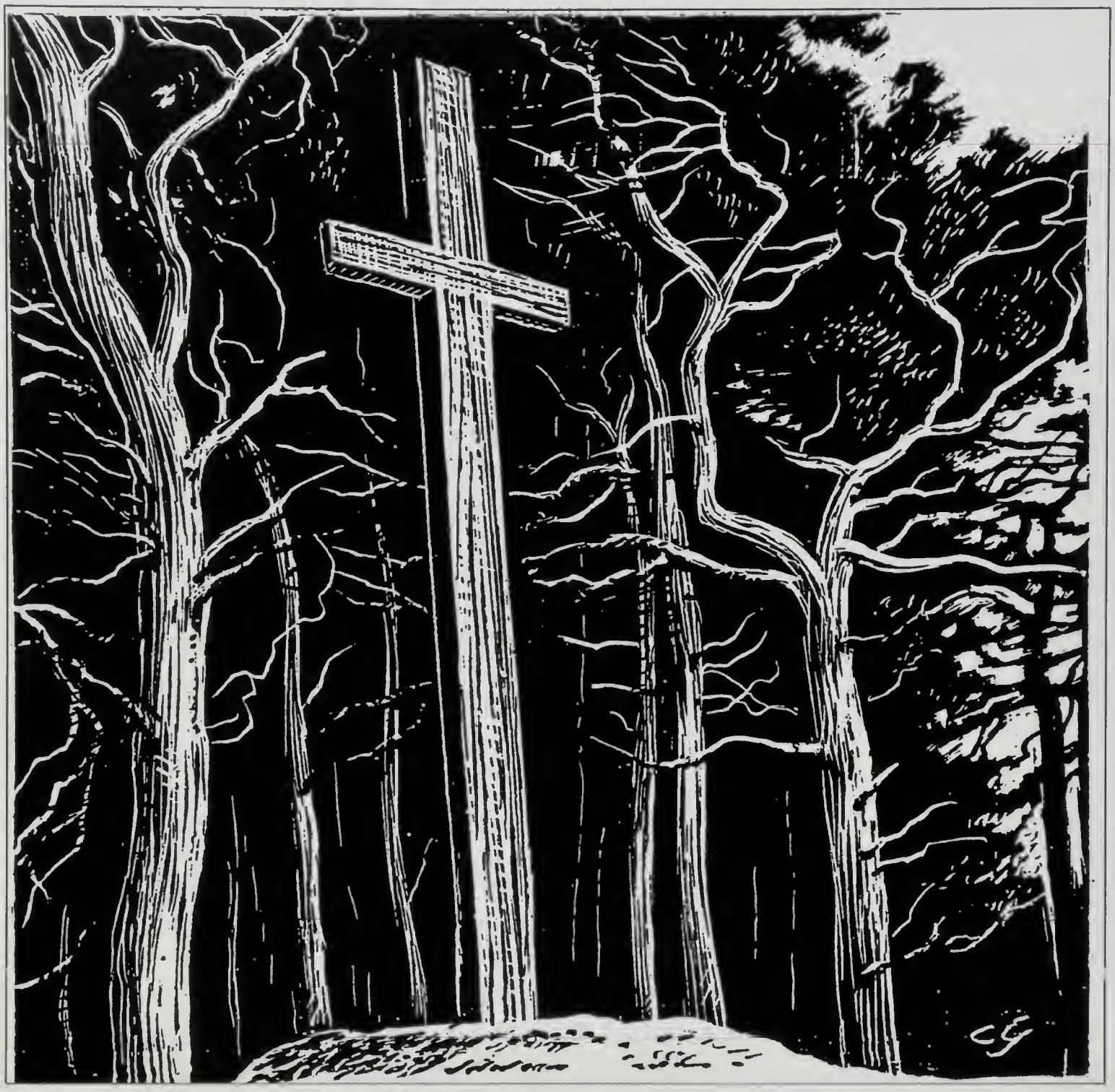

Figure 7

The Polish War Memorial near Buddon Camp, showing the plantation of Scots Pine in the background. Illustration by Colin Gibson, drawn during the 1950s.

impractical; in his evidence to Dundee Harbour Board in March 1845, Hunter stated that in the period 1828-38, 28 vessels had been lost at the entrance to the Tay, seven with all hands. Although a lifeboat was stationed at Buddon Ness, the crew lived six miles away. Hunter's plan was to build fishermen's cottages at Buddon, so that they could crew the lifeboat. The plan was dropped after John Kennedy of the Seamans' Fraternity pointed out that fishermen would be unable to launch their boats from Buddon (Anon., n.d.)[51].

Army buildings of wood or metal crop up like mushrooms all over Barry Buddon, and like mushrooms, most have short lives. Nevertheless, some huts probably dating from World War II and earlier remained in use at Buddon Camp until replaced by more modern accommodation in the 1990s. Recent army structures have tended to be of more permanent materials than their forebears, the most ephemeral modern 'buildings' being the brightly-coloured plastic portaloos that are a recent addition to the firing ranges.

The army also installed some 2 km of narrow-gauge (24 ins.) tramway track, mainly with cast-iron sleepers, for pulling moving targets or carrying equipment. This mostly dates from the 1930s and 40s, and is now largely disused, although one of the tracks, constructed in 1940, was still in use in the 1960s (Brotchie, 1965), and all the lines remain as an interesting part of the heritage of the Links. Relics of army occupation such as the iron 'beehive' observation shelters overlooking the artillery range, and the trench system on Barry Ridge which probably dates from around World War I (when training trenches were dug on a number of army training grounds - Brown, 2004) may well be of interest to military historians, and should be valued as part of the recent archaeological record. Other, infilled training trenches, probably of similar date, are recorded by RCAHMS as showing in aerial photographs as cropmarks between the main camp road and the railway.

14. Shipwrecks and Lifeboats

Shipwrecks

While the Firth of Tay is an excellent harbour, the Gaa and Abertay Sands at its mouth, forming steep walls up to 6 m in height above the channel bed, have always been a hazard to shipping passing through the "narrow, variable and difficult" entrance channel. The dangerous shoals were sometimes locally called the Roaring Lion, because of the roar of the waves, and gave the title to a Victorian gothic poem '*The Moaning of the Tay*' by the Carnoustie poet Thomas Gray (Reid, 1897). Perhaps the most famous wreck in the Firth was that of General Monck's Cromwellian fleet of 60 ships, lost while carrying looted treasure from Dundee in 1651. The RCAHMS

Canmore database records about nine wrecks at or near to Buddon Ness between 1847 and 1940, but many more are known (over 70 between 1846 and 1865 alone; Anon., n.d.; Jack, 1865), and others must have been forgotten. In days gone by, wrecks were a regular occurrence and drownings were frequent - tragedies were common enough for there to be "vulgar reports" of the people of Barry's "inhumanity to shipwrecked mariners" (Sim, 1791-99). The records of Barry Kirk Session rebuke two men who found a dead man near the lighthouse one Sunday in 1722 and robbed the body of money and other valuables - although the main offence seems to have been regarded as Sabbath-breaking rather than theft ('KT', 1897)! Little wonder that there are vague local tales - that were doubtless encouraged by smugglers - of a ghostly drowned woman haunting the remote area of Buddon Ness south-east of the lighthouses.

Blackadder (1826) mapped what appears to be a stony area low on the shore about 1,500 m WNW of the 'large lighthouse', marked "place where a vessel was stranded" - the rocks may have been ballast, or a cargo of stone. Most vessels driven ashore in storms were small, as can be seen from the scanty remains occasionally exposed on the shore. For a few years afterwards, locals might remember them more by their cargo than by name or date - 'the Onion Wreck', 'the Apple Wreck'[52], 'the Bottle Wreck' ('RJBS', 1950). On 11 April 1708, Barry Kirk Session recorded that many parishioners broke the Sabbath by taking brandy from a cask found upon the shore - so many that they could not all be compelled to appear before the congregation to answer for the offence ('KT', 1897)! More rarely, even quite large vessels would fall foul of the Abertay Sands, for example the steamer *Dalhousie*, lost with all hands in 1864, and the SS *City of Naples*, beached and holed (though later refloated) in 1919 on Buddon Ness itself. A medium-sized hull visible for many years was that of the Estonian barque *Uku*, driven ashore by gales on the east side of Buddon Ness in November 1927. A heroic rescue effort meant that only one life was lost, but with the ship left high and dry almost on the dunes, it was stripped of all cargo and decking, and the hull was burnt about a year later. What remained became a well-known landmark. Years later it was washed round the headland, buried, and later uncovered - a demonstration of the power of the currents and the shifting nature of the dunes.

A few of the wrecks were casualties of war; in January 1940, two ships hit parachute mines that had been dropped by German aircraft in the approaches to the Firth. The 8,300 ton passenger-cargo liner *City of Marseilles*, bound for Dundee with a load of jute, was the first victim; it was later towed into Dundee harbour. Three weeks later, the *Anu*, a 3,028 ton Estonian steamer sailing from Sweden with a cargo mostly of butter and ham, was more unfortunate, and was blown apart by a magnetic mine, suffering serious casualties and losing its cargo to be collected from the beaches by local people (Pyott, 2001); those survivors from the ship who reached Buddon Ness wandered the links in the darkness until dawn showed the way to blacked-out Carnoustie.

Even today, with modern navigational aids, ships are at risk of grounding at the mouth of the Tay. The 17,000 tonne liner SS *Uganda* was stranded on the Tay Bar for a few hours in 1977. More tragically, the Broughty Ferry lifeboat *Mona* was washed ashore near Carnoustie in December 1959 with all eight crew dead, after being called to assist the North Carr light-vessel which had been in difficulties during a storm. Two other vessels grounded at Buddon later in the 20th century were the *Hayo* and the *Fendyke* (1979). There must have been some irony in the choice of the name *Buddon* for one of the tugs used to manoeuvre ships into Dundee Harbour in the mid-20th century.

Lifeboats

Following a series of gales and wrecks in late 1829, the Tay's first lifeboat was purchased by public subscription (Jeffrey, 1996). It was stationed in a wooden hut at Buddon Ness from 1830 until 1894, although its first call-out was not until 1835. The station was operated by the River Tay Lifeboat and Humane Society, and in emergencies the boat was crewed by fishermen from Broughty Ferry or Westhaven, with the key to the hut being held by the Buddon lighthouse-keeper. The crew were paid a bounty of one guinea (£1.05) for attending call-outs, with a bonus of £1 if lives were saved.

Despite the isolated location, in the days when lifeboats were rowed, it was thought quicker and safer to have the boat stationed near the usual 'disaster area', rather than near its crew - indeed, one hardy crewman argued that, far from fatiguing them, the walk made them more able to put to sea! Without engines, it was thought that reaching the mouth of the Tay from Broughty Ferry would be impossible in the face of a flood tide and an easterly gale. A suggestion that a carriage capable of carrying a full crew should be kept at Broughty Ferry was turned down on the grounds that the terrain of Buddon Ness was too rough for such a vehicle. Getting to the lifeboat was not the only challenge for the crew - in 1837, the slipway was so buried by blown sand that launching required a major digging effort.

Although a rowing-boat (with sails), the lifeboat was no pram dinghy - the first boat cost £130 (a substantial sum in 1830), was fitted with 12 rowing and two steering oars, and could hold 25-30 survivors in addition to the crew. The laying of launching rails added a further £200 to the initial outlay. There were a succession of four Buddon lifeboats, with the station continuing in service for many years after a larger vessel was commissioned, first based briefly at Green Scalp, Tentsmuir from 1848, and later at Broughty Ferry (from 1859). The Buddon lifeboats were responsible for saving many lives - over 100 between 1863 and 1894 (Malcolm, 1910; Jeffrey, 1996), although towards the end it became merely a supplementary boat to the one stationed at Broughty Ferry, and was seldom called on. Like the lighthouses, the service was

funded by a tax on vessels entering the Tay, until it was taken over by the RNLI in 1861 after experiencing some financial difficulties and running up debts of over £100. The last lifeboat hut, close to the ice-house, survived until the 1950s (Gibson, 1955), but has long since been swept away.

15. Beachcombing and Pollution

The strandline is a paradise for beachcombers: as well as the inevitable rubbish, all kinds of natural and man-made treasures turn up on the beach. The south-west shore facing the Tay estuary is the best hunting-ground - the open coast of Barry Sands is too exposed and wave-swept to allow much debris to accumulate, and where coastal protection backs the shore, there is little or no beach where it can collect. Antique Victorian bottles released by erosion of the dunes may occasionally be found, next to plastic detergent containers dropped into the Firth at Dundee Docks. Many years ago, 'Jock', a local tink, made much of his income by gathering returnable bottles to collect the deposits. Driftwood is abundant - fine lengths of sawn timber lost overboard, and complete trees washed downstream by the Tay. The beach is famed for its banks of cast-up shells, mainly of common bivalves that burrow in the sand. The hungry gourmet beachcomber might be tempted not only by the shellfish by the variety of fruit and vegetables often found on the strandline! The most common hazardous rubbish is broken glass, a reminder of the debris that formerly eroded from the dump at Monifieth, or from bottles that float ashore complete and are smashed by vandals.

The beach escapes most pollution other than litter. The open eastern shoreline is particularly clean, while within the Firth of Tay, visible sewage pollution on Buddon Sands was not particularly acute even before Dundee's new sewage outfall was commissioned in the 1990s, to be followed later by a sewage treatment system. Since 2002, sewage discharges to the Tay from Dundee have ceased altogether, and the water quality in the outer Firth is Class A (excellent). Occasionally oil-contaminated debris is washed up, but stricter controls and Dundee's decline as a port means that oil pollution is much rarer than formerly (Rangeley, 1970). The Buddon shore escaped the worst direct effects from the Tay's most serious oil pollution event, in 1968, when the leaking tanker *Tank Duchess* lost 87 tonnes of oil, killing over 1,300 birds, mostly Common Eiders *Somateria mollissima* (Greenwood and Keddie, 1968).

Normally the Tay is one of Britain's cleanest rivers, and its enormous flow helps to dilute what pollution does occur. This probably helped to preserve the relatively pristine beaches even when pollution control legislation was weaker than it is today[53]. Sewage from Buddon Camp formerly discharged into the Buddon Burn, but a sewage treatment works was installed in 1980, and the Camp was connected to

mains sewerage in 2000. Persistent pollution from Kingennie Quarry, north of Monifieth, was also brought under control by the early 1980s (Woolven, 1987). However, both the Buddon and Barry Burns have largely agricultural catchments and suffer farm pollution - in 1995, a Kingennie farmer was fined £1,000 for allowing contaminated effluent from a dung heap to enter the Buddon Burn in June 1994. Although water quality has shown some improvement, the catchments of both burns were recommended for designation as Nitrate Vulnerable Zones by SEPA in September 2001. In former times, both burns held trout.

16. Botany

Vascular plants

Barry Buddon is of considerable botanical interest. In the early 19th century the Forfar botanist George Don, and subsequently William Gardiner of Dundee, author of the first flora of the county, both thought Barry Buddon a happy hunting-ground. Ingram (1968) gives a general account of the flora, and a number of vegetation surveys have been carried out (Milne, 1976; Woolven, 1987; Dargie, 1995, 2001). A total of 352 higher plant species have been recorded from Barry Buddon (McCurley, 2003). Several nationally scarce and locally rare plants occur here, including the Baltic Rush *Juncus balticus* near the mouth of the Buddon Burn, one of its southernmost locations. The declining Curved Sedge *Carex maritima* was recorded nearby in the 1950s, but by the 1980s its station had been invaded by Common Reed *Phragmites australis* (David, 1982)[54]. At the top of the shore at Buddon Links Golf Course, close to the mouth of the Barry Burn, is a colony of Sea Pea *Lathyrus japonicus* var. *acutiformis*, a rare plant that may have more in common genetically with mainland European populations on the opposite side of the North Sea than with more southerly British populations. It has been the subject of detailed study and conservation efforts (Cook, 1996), but the population can fluctuate greatly from year-to-year (Cook, 1997), and is vulnerable to habitat change. Another colony near Monifieth was destroyed by development many years ago (Randall, 1977).

Some other plants worthy of note include Maiden Pink *Dianthus deltoides*, Grass-of-Parnassus *Parnassia palustris*, Early Forget-Me-Not *Myosotis ramosissima*, Wild Basil *Clinopodium vulgare*, Gipsywort *Lycopus europaeus*, Rush-Leaved Fescue *Festuca arenaria* and the local Dark-Leaved Willow *Salix myrsinifolia*. Water Dock *Rumex hydrolapathum* and Green Figwort *Scrophularia umbrosa* are present here at one of their northernmost locations, as is the parasitic Yellow Bartsia *Parentucellia viscosa*, introduced probably via a seed-mixture, and the introduced Smooth Rupturewort *Herniaria glabra*. A road verge in the links was recently found to support Betony *Stachys officinalis*, a rare plant in Scotland with no other extant

stations known in Angus. Several species of orchid also occur, notably Coralroot *Corallorhiza trifida*, Common Twayblade *Listera ovata* and Lesser Butterfly Orchid *Platanthera bifolia*. A number of unusual willow *Salix* hybrids have been recorded (Rechinger, 1950; Hogarth, 2004), one of which, *Salix* x *angusensis* (*S. viminalis* x *S. cinerea* x *S. repens*) had until recently been identified nowhere else (Meikle and Robinson, 2000), and is named after the county (Stace, 1997). A plant which has been lost is Sea-Holly *Eryngium maritimum*, which was found "plentifully at the light-house" in the early 18th century by Blair (1722), yet was rare by Gardiner's time, and is now extinct in the county (Ingram and Noltie, 1981), as from all its former stations in east Scotland. Amongst the ferns, the most noteworthy is the inconspicuous Adder's-Tongue *Ophioglossum vulgatum*, while Moonwort *Botrychium lunaria* is present at one of its few remaining east coastal sites. Specimens of *Botrychium* collected from Barry Links in 1839 helped fuel a debate during the 19th century over whether more than one species occurred in Britain (Newman, 1854a,b; Whitwell, 1898), but the Barry plants were eventually decided to be merely examples of the natural variability of *B. lunaria*. Woolven (1987) and Hogarth (2004) list other noteworthy species present.

Charophytes

Pools on Barry Buddon were considered of local importance for charophytes, with old records of three stonewort species including the nationally scarce *Tolypella glomerata* (Stewart, 2004), but they have not been investigated recently, so it is not known whether they survive here.

Bryophytes

Barry Buddon was once considered one of the key dune systems for bryophytes in Britain, with the most important bryophyte communities being present in and around the dune slacks. A total of 110 mosses and 31 liverworts have been recorded (McCurley, 2003). While some of the most noteworthy species have been lost, Barry Buddon has suffered less disturbance than other coastal sites, and remains of national importance, with an unusually large number of rare mosses and liverworts (Chamberlain, 1979), including the mosses *Bryum calophyllum*, *B. knowltonii*, *B. marratii* and *B. warneum*. The local extinction of some bryophytes has been blamed on the drying-out of the dune slacks (Duncan, 1966; Chamberlain, 1979), but a more recent possible contributory factor could be deposition of atmospheric nitrogen pollution, an influence identified at some other dune sites (Jones *et al.*, 2002). Nitrogen deposition in the area is towards the maximum critical load for most sand dune habitats (APIS, 2004), and any additional inputs such as those associated with groundwater could easily produce damaging levels. Duncan (1966) also considered

acidification to be a factor, but by the 1990s pollution control measures meant that the links were not considered to be at serious risk from sulphur deposition (Ross, 1993).

Lichens and fungi

There are extensive lichen-rich terricolous communities. A total of 111 taxa have been recorded, but a number of local species have not been refound since the 1840s - Woolven (1987) suggests that pollution from Dundee may have impoverished the lichen flora. Despite this, Ranwell (1980) considered Barry Buddon to be one of the most species-rich sand dune sites in Scotland. Coppins and Coppins (1996) recorded 45 lichens, including two Red Data Book taxa, *Cladonia mitis* and *C. uncialis* ssp. *uncialis*. Some of the species, such as *Cladonia cornuta* and *Cetraria islandica* are more typically found in upland habitats, occurring only very rarely on coastal heaths and sand dunes, whilst *Cladonia arbuscula* ssp. *arbuscula* was a first record for the UK. The boulder revetment emplaced along the coast has provided a new lichen habitat, with the upper rocks already colonised by yellow *Xanthoria* and other species characteristic of rocky shores. Macrofungi were recorded by Watling and Rotheroe (1989)[55]; 86 taxa have been identified to date (SNH, 2005).

Plant communities and vegetation management

Despite the presence of the noteworthy species mentioned above, it is Barry Buddon's vegetation communities, rather than individual plant species, that are most important. The sand dunes immediately behind the coast are typical of sandy coastlines, with Lyme-Grass *Leymus arenarius* on the younger, more mobile dunes near the coast, and Marram *Ammophila arenaria* extending from the mobile dunes well inland. Farther inland, Barry Buddon is particularly important for its extensive and relatively intact 'back dune' communities, including dune heath and grassland - habitats that, at many other duneland sites, have been lost to forestry, agriculture or development. A more complete range of successional communities survives than at, for example, Tentsmuir. The communities are surprisingly different from those across the Tay at Tentsmuir, even prior to its afforestation. In common with most large east coast dune sites, the soil of both dune systems is relatively acid, with a calcium carbonate content of just under 1% (Shaw, Hewett and Pizzey, 1983). Perhaps Tentsmuir is the more acid of the two systems; it was at one time managed as an artificially-stocked grouse-moor (Berry, 1894; Smith, 1948) with extensive Heather *Calluna vulgaris*, a species that, though present, never seems to have been as widespread or dominant at Barry Buddon in recent times. In addition to heather, the dunes at Tentsmuir Point support other heath species including Crowberry *Empetrum nigrum*, a species entirely absent from Barry Buddon. This is just one of the more obvious differences between the dunes to the north and south of the Tay (Ingram, 1968). Some of these differences may be natural, perhaps reflecting subtle

differences in pH or soil nutrient status[56], while others may reflect past land-use, particularly differences in grazing regimes and a recent history of fires at Barry Buddon resulting from army training activities. It is known that in the past Tentsmuir's vegetation was transformed by heavy grazing and injudicious burning in the early 19th century (Whittington, 1996b) and earlier, in the 5th-7th centuries (Whittington and McManus, 1998).

Although dune heath is one of the most important habitats at Barry Buddon, it has shown a long-term net decline in extent through conversion to fixed grassland, scrub and woodland (Dargie, 1998). Barry Buddon today is most characterised by grassland, while woody species have become more widespread. Site Condition Monitoring of Barry Links SSSI carried out for SNH in 2001 found all four key dune habitats (strand, embryo and mobile dune; fixed dune; dry dune heath; and dune slack) to be in unfavourable condition. As qualifying features on a designated SAC, there is now a legal obligation to prevent deterioration of these habitats, and the current management plan has their maintenance and enhancement as one of its objectives (SNH, 2005). Grazing forms an essential part of this management.

The dune slacks are another particularly important habitat, with Creeping Willow *Salix repens* ssp. *argentea*, together with other willows, colonising the mature slacks and stable dunes. Heavily rabbit-grazed areas near Buddon Ness support a sparse bryophyte growth on bare sand between the Marram tussocks. However, the slacks are another declining habitat, with few new examples being formed, and the older slacks being colonised by grassland and scrub (Dargie, 1998). Duncan (1966) reported that the dune slacks near the lighthouses had become more acid, as well as drier, since 1938[57]. Dargie (1995, 2001) and Woolven (1987) describe the vegetation communities in more detail.

In the past, large areas were burned by the army authorities (Milne, 1976), a practice which doubtless limited the spread of trees and scrub. Burning may have formerly helped prevent the introduced Sea-Buckthorn *Hippophae rhamnoides* from becoming more dominant over larger areas. Despite the provision of fire-beaters, fires still occur, sometimes over fairly large areas, started by vandals, or accidentally by military pyrotechnics or old munitions. Tackling these fires can be hazardous, due to the possible presence of unexploded munitions. Initial regeneration can be rapid (Milne, 1976), and one recently-burned area was found to support a large population of Adder's-Tongue *Ophioglossum vulgatum* (Fulford, 1991). Long-term recovery of some habitats is less certain; dune heath can take decades or even centuries to recover from serious fires (Vestergaard and Alstrup, 2001), and Dargie (1998) considered uncontrolled burning to be a likely factor in the decline of dry heath at Barry Buddon. A history of accidental fires probably accounts for the virtual absence of mature stands of Heather *Calluna vulgaris* (Dargie, 2000).

The potential for radical intervention to benefit certain features, such as stripping vegetation or artificially deepening dune slacks, needs to be balanced against possible short-term impacts on other biological or geomorphological interests, to say nothing of military use of the area. Species that thrive on disturbed ground benefit from army manoeuvres and digging by rabbits, but army trench-digging is restricted to certain areas, and (apart from some permanent timber-lined trenches), troops are required to fill in their trenches and reinstate the turf once the exercise has been completed.

It remains to be seen what will be the effect the removal of sheep grazing. Experience at other duneland sites suggests that, unless compensated for by more intensive rabbit grazing, an initial recovery in vegetation might be expected, followed by a long-term reduction in botanical diversity (Doody, 1989). However, on acid dune systems, excessive grazing may convert dune heath to species-poor grassland (Leach, 1985; Boorman, 1989) - but, particularly with several factors working in tandem, there is no guarantee that removal of grazing will restore the original vegetation. Well-managed cattle-grazing typically brings about greater botanical diversity than sheep grazing, although the benefits may be more limited where the cattle are confined to fenced areas, as at Barry Buddon. At a study site on Monifieth Links, MacInnes (1997) found that intensively (rabbit) grazed areas had greater species diversity than an area from which grazing animals were excluded - although the exclosure was part of a restored pipeline excavation, so may not have been typical. The problem of achieving an appropriate type and intensity of grazing is one faced by many dune managers (see, for example, Boorman and Boorman, 2001; Packham and Willis, 2001), and no single approach is likely to be suitable for all sites and management objectives.

At Barry Buddon, grazing for conservation management is a new concept, and is likely to involve some 'trial and error' before the most appropriate grazing regime is established. Although it is too early to tell if cattle grazing will be successful in restoring the extent of dune heath at Barry Buddon, the existing dwarf shrub cover within the grazed enclosure was much more obvious even by the end of the first season, as it was apparent that the animals were selectively grazing on the grasses that had become dominant over much of the area.

Trees and woodlands

As noted above, Barry Buddon was naturally virtually treeless. A square plantation appears on a 1775 map; on a 1785 chart it is shown apparently enclosing a field, and two plantations are shown in 1794 (Ainslie, 1775, 1785, 1794). The *Old Statistical Account* records that "an extensive clump of firs planted in the links of...Barrie has thriven well" (Roger, 1791-99). Headrick (1813) describes how "The late Mr Hunter of Blackness, by way of experiment, planted a large body of Scotch firs [Scots Pine

Pinus sylvestris] on the Sands of Barry, at a considerable distance from the sea, but without much intervening shelter. As far as they have gone, they have thriven very well…this plantation affords a fulcrum, under whose shelter the plantations may be extended in all directions, until these barren and unseemly sands be clothed in thriving wood." Much later, Warden (1881) also wrote approvingly of the "plantations of dark pine which relieve the monotony of the…plain". Although techniques for afforesting unvegetated dunes (using fencing and brushwood thatching) had been developed in France as early as the 1780s (Ross, 1992), it is likely that the writers would have mentioned such novel methods if they had been used at Barry Buddon, so we may infer that the site chosen for Hunter's plantation was not completely bare sand at that time of planting.

Early cartographers seem to have struggled to map the largely featureless foreland accurately, and were probably most concerned with delimiting coastal fishing-stations rather than the interior, which complicates interpretation of the history of the plantations. In the 19th century more reliable surveys (Thomson, 1825; Blackadder, 1826; Knox, 1850) placed the woods farther inland than previously indicated. The larger, more southerly plantation (called Fir Park by Blackadder (1826), but later known as Big Wood[58]) lies slightly to the north-west of the centre of Barry Buddon, west of the present Lighthouse Road, while a smaller, northern one near Cowbyres lay just to the north of the line of the railway, and no longer survives. Horne's (1842) plan shows several other woods on Pitskelly Estate's Cowbyres Lands - it would seem that some of these either failed to become established, or that they were never actually planted.

At the time of the army takeover, Barry Buddon remained largely treeless apart from the 18th century Big Wood and some planting around one or two of the old steadings. The most obvious change to the landscape brought by the army was the planting between 1891 and 1920 of two belts of Scots Pines (lately called Old Wood and Confidence Wood, but originally referred to as 'the New Forest') near Buddon Camp, and some planting on Barry Ridge. As well as providing shelter, the trees gave cover in training exercises and enabled firing at concealed targets. By 2002, Confidence Wood was felled, yielding a crop of timber. Although these trees grew well, a small shelterbelt of conifers planted much later beside the High Lighthouse failed to thrive.

In the late 1970s, a new phase of woodland planting commenced, primarily for amenity and shelter, but also to create a more diverse environment for army training. These plantings concentrated on the northern section, away from the areas of greatest scientific interest. Although mainly of broadleaved trees, the species were not necessarily native, being chosen according to the situation and soil in each area. Plantings in 1977-82 involved some hundreds of trees each year as resources

permitted, until, in 26 small enclosures, some 3,000 trees of a very mixed selection of some 20 species including Norway Spruce, Scots Pine, Lodgepole Pine, elm, Beech, oak, birch, Alder, willow, Gean, Rowan, Whitebeam, Hawthorn, Broom, Gorse, Sea-Buckthorn, maple and Sycamore had been planted (Anon., 1978, 1979, 1983a, 1983b); Alder, willow and oak were also planted around the Water Obstacle (Anon., 1980). In 1983, a grant of £6,000 enabled an intensification of planting; using soldiers and conservation volunteers, a further 14,150 Norway Spruce, larch, Scots Pine, elm, Beech, oak, birch, Alder, Hornbeam, Rowan, Whitebeam, Hawthorn and Ash were planted in 14 ½-acre (0.2 ha) enclosures along the northern edge of the ranges, using peat compost to give the trees a start in the sandy soil (Anon., 1983b); some of the planting took the form of hedges. Woolven (1987) observed that the new plantings had received little in the way of aftercare, but despite this neglect, the planted areas are rapidly assuming a wooded aspect. More recently, as part of Angus Millennium Forest, a new Barry Links Wood has been planted just outside the site boundary, close to Barry Station.

Apart from trees planted by the army, and a few survivors from earlier plantings, natural scrub also occurs widely. The most attractive areas are well-established mature scrub in the vicinity of Barry Ridge and neighbouring Happy Valley, where there are stands of Hawthorn *Crataegus monogyna* with Alder *Alnus glutinosa*, willows *Salix* spp. and wild roses *Rosa* spp., along with some introduced Sea-Buckthorn *Hippophae rhamnoides*. The nitrogen-fixing properties of the latter species encourage the growth of Elder *Sambucus nigra*, especially where the ground is disturbed by rabbits. In the sheltered valleys, some of the shrubs grow to be small trees. What was described by Gibson as "the finest natural stand of hawthorn on the east coast" grew farther west on Monifieth Links, and was destroyed when the dunes were buried under the rubbish dump. By the 1970s, Big Wood was dominated by self-sown Downy Birch *Betula pubescens*, and was described by Milne (1976) as "mostly natural", despite the presence of well-grown specimens of other species which had almost certainly been planted, including Beech *Fagus sylvatica*, Pedunculate Oak *Quercus robur*, Scots Pine *Pinus sylvestris* and a single Apple *Malus sylvestris*. The introduced Snowberry *Symphoricarpos rivularis* forms several large clumps in the north-eastern part of the wood but has not yet become a widespread invasive species. A survey by Tidswell (in Woolven, 1987) considered the woodlands to be of low botanical interest.

Probably because of grazing pressure, the pines have shown little natural regeneration until recently (in contrast to the situation at Tentsmuir), and a few mature trees have been lost to natural causes and locally even felling on Barry Ridge. By early 2004, less than two years after sheep grazing finally ceased, young pine seedlings were becoming visible in the dune heath south-west of Barry Ridge. Broadleaved tree species, especially birch, have been able to regenerate more freely,

and Big Wood has extended considerably, with much more scrub also becoming apparent away from the woodlands. The age of many of these trees suggests that they may have benefited from the temporary reduction in rabbit numbers due to myxomatosis during the 1950s and 1960s, and possibly from the more recent reduction in sheep grazing, before it finally ceased altogether (Woolven, 1987). A lower water table with reduced winter flooding will also have allowed scrub to invade the dune slacks, and once established, the trees are likely to contribute further to the drying-out of the area.

Today, Barry Buddon is more wooded than at any time in the past. Although, as Woolven (1987) observed, in the absence of a control area for comparison, it is difficult to fully assess the effects of grazing even while it is taking place, without active intervention the trend away from dune grassland towards more woodland seems likely to continue following the cessation of sheep pasturage and reduction in burning, and as the recent tree-plantings reach seed-bearing age. A scrub management plan was drafted in 1999, but financial constraints prevented its implementation at that time. However, some areas of Sea-Buckthorn have been earmarked for clearance as soon as funding becomes available. In 2000 a woodland management plan was produced, and began to be implemented in 2003/04. Ten hectares of young birch woodland that had sprung up around Big Wood were mechanically cleared, together with a number of smaller compartments within the wood, with waste wood being chipped and spread on site, and some larger logs being left as deadwood habitat stacks. This work took place within the cattle enclosure, with the intention of both diversifying the habitat and improving the woodland for army training purposes; combined with cattle grazing, this work may enable the regeneration of some of the dune heath. Further felling coupes are planned within the woodlands. Farther west, recent work by Dundee Conservation Volunteers has also included scrub clearance on Monifieth Links.

17. Birds

Barry Buddon's ornithological interest is considerable, though possibly under-recorded in the past. A total of 59 bird species have been confirmed as breeding in recent years (McCurley, 1997; B. McCurley pers. comm., 2003). This total is about ten fewer than were recorded breeding by Ellwood (1981b). Some former breeders such as the Corn Bunting *Miliaria calandra* have now been lost from the area entirely, while some recent arrivals such as the Common Coot *Fulica atra* have benefited from the creation of new habitats. Neither total counts one or two particularly remarkable incidents: the first British breeding attempt by Long-Tailed Skua *Stercorarius longicaudus* in 1980[59], or the curious case of an apparent small colony of Ruddy Shelduck *Tadorna ferruginea* that were present in the 1870s and 1880s (Drummond Hay, 1887). Dozens of Skylarks *Alauda arvensis* singing in

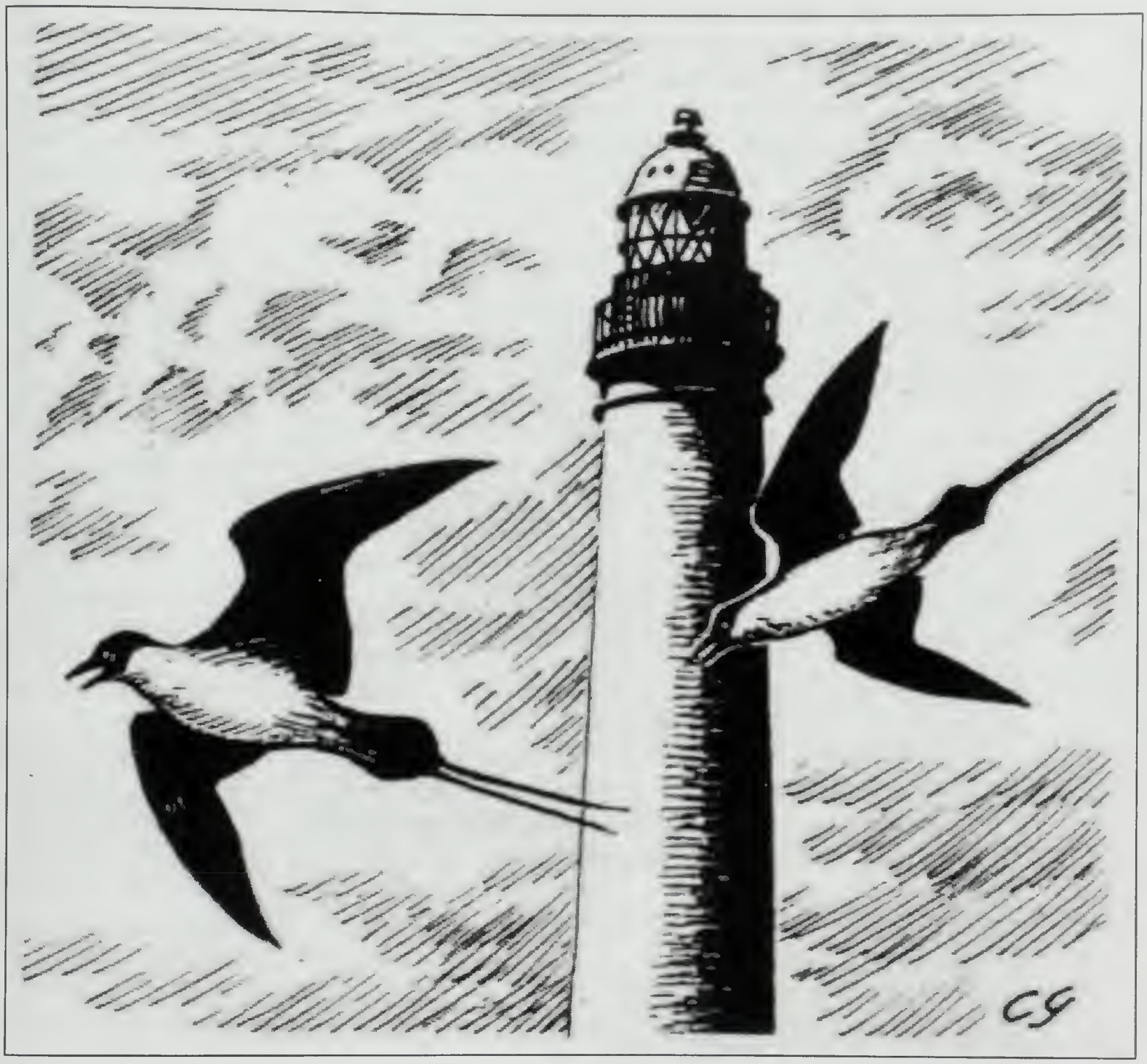

Figure 8

Long-Tailed Skuas near the lighthouses, summer 1980.
Illustration by Colin Gibson

summer demonstrate the value of the grassland to ground-nesters; Short-Eared Owls *Asio flammeus* can be seen hunting over the grasslands, but are mainly a winter visitor. Tree-nesting birds have more limited habitat, but Tawny Owls *Strix aluco* and Long-Eared Owls *Asio otus* live in the pinewoods, and the shrubby areas provide nesting-sites for many species; nestboxes have been provided to encourage hole-nesting species.

The bushes also give shelter to migrant birds arriving on the headland; when the lighthouse was operating, many night-flying migrants used to dash themselves against the glass, and once a flock of crows or rooks blacked out the light-beam altogether (Gibson, 1955). Some early migration records for Buddon Ness were published by Boase (1927). Attempts in recent years to diversify the habitat by planting shrubs and trees and creating new wetlands may have enhanced the value of the area for migrants; a further 21 wintering species and 47 passage migrants have been recorded (McCurley, 1997, 2003), although access restrictions mean that many probably pass through unrecorded by birdwatchers (Green, n.d.). McKay (2004) reported productive observations of passage birds flying past Buddon Ness. Buddon Ness serves as an occasional roost for some of the Pink-Footed Geese *Anser brachyrhynchus* that winter in the southern half of Angus and on the Tay estuary (Mitchell and Hearn, 2004).

It is for seabirds that the area has been most noted. Small flocks of waders patrol the shore, and various species of gulls scavenge along the strandline. Common Shelduck *Tadorna tadorna* returned to breed in the links near the mouth of the Buddon Burn in 1987 (Woolven, 1987), near to where they were first recorded in the *Old Statistical Account* (Roger, 1793). Mute Swans *Cygnus olor* also formerly bred near the mouth of the Burn, and returned in 1997 after a long absence as a breeding species to nest on a small island in Barry Loch (Anon., 2002). After an even longer absence, the Black-Headed Gull *Larus ridibundus* returned in 1980 (Ellwood, 1981b), having been lost as a breeding species a century earlier; by the mid-1980s a large colony was established once more.

Although Atkinson-Willes (1963) wrote of eider that "Buddon Ness was never used extensively as a breeding ground", and even quotes an assessment by Boase (1955) that the site is "now virtually deserted", a significant number of Common Eider *Somateria mollissima* nested in the dunes; their success in the late 1970s was attributed to the control of crows undertaken at that time by the Camp Commandant, Major Stephen Ellwood (Anon., 1980). The eastern part of the links between the firing ranges and Buddon Ness was their favoured nesting-ground (Woolven, 1987), and by around 1990, there were approximately 120 nests (SNH, 2005) - a huge increase over the ten nests located by Pounder (1974), or the 12 found by Gibson (1955). Crows are still controlled, using Larsen traps and shooting by a rough

shooting syndicate, and foxes are also controlled, but the boulder coast-protection since placed behind Barry Sands presents an almost impassable hazard to flightless young ducklings, and the number of breeding eider has rapidly declined, with just three nests found in 1997. Larger flocks can still be seen off Buddon Ness, or feeding on the Broughty and Monifieth mussel beds - up to 15,000, the largest concentration in Britain, formerly wintered in the Tay estuary (Pounder, 1971), but numbers have apparently declined significantly since the early 1990s (Cranswick *et al.*, 2005). The eider circulate around the Firth depending according to tidal movements, spending high tide over the mussel beds off Broughty Ferry before drifting eastwards on the ebb to feed between Buddon Ness and Abertay Sands, and finally returning upstream as the tide turns (Campbell, 1978). Offshore, the open waters of St Andrews Bay to the south and east of Barry Buddon also support important wintering concentrations of other seaduck and divers (Dean *et al.*, 2003, 2004).

Once there were big terneries near Buddon Ness, but numbers of breeding pairs were so reduced in the late 19th and early 20th centuries that Marples and Marples' (1934) classic monograph mentions only one or two historical records from Barry Buddon. Even before Barry Buddon became a full-time army training ground, some of the birds were directly affected by firing. Firing on the artillery range was from near Buddon Camp south-east towards the Gaa Sand Hill, which seems to have been the favoured site for the terneries. Drummond Hay (1881) described how they had been much reduced by artillery practice, "the shot passing over their favourite station, to the great discomfiture of the birds". Corr (1912) also attributed a decline to the impact of firing practice: "during a considerable part of the year, instead of the trilling cry of the curlew, and the shrill pewit of the lapwing, we hear the crack of the rifle and the boom of the cannon, so that this district has ceased to be a breeding station". Boase (1962) considered that the disturbance had reduced breeding populations to small numbers. It must be remembered that this was before sensitive areas were put 'off limits' for exercises. It is also quite possible that troops collected eggs to supplement their rations - one of the factors that, along with practice shooting, contributed to the virtual extinction of the once-large terneries at Tentsmuir (Grierson, 1962). The decline in the extent of bare sand as the dunes became increasingly vegetated may have been a further factor that reduced the suitability of the links for nesting terns.

In the 1950s five species of tern were again nesting (Summers, 1972), but this recovery was only temporary, and by the 1970s, disturbance and egg-collecting had once again largely finished the terneries. There was another partial recovery around the early-mid 1980s, including a nationally-important colony of up to 40 pairs of Little Terns *Sterna albifrons* nesting between 1978 and 1988, but this was not sustained; again egg-collecting was a problem (Anon., 1980), despite efforts to guard the nests. By the late 1990s only a few pairs of tern continued to nest, struggling against predation and exceptionally high tides. The move away from the traditional

nesting ground on the Gaa Sand Hill, and the increasingly vegetated nature of the links, seems to have forced the terns onto the sub-optimal habitat of the beach. Large numbers of terns may still be seen on passage, and 2002 saw the commencement of a recovery project in an attempt to encourage them to breed. A small area around the ruins of the Low lighthouse-keeper's cottage was fenced to exclude foxes, and to attract the birds, ceramic model terns made by children from several Dundee schools were placed on the ground (SNH, 2002), but to date the project has had little success; alternative sites and even the playing of taped tern calls may be tried if necessary.

Apart from problems of egg-collecting, disturbance and trampling, illegal shooting was a problem at one time, resulting in various species of birds being killed or injured by shotguns or air-rifles. A driftwood hide overlooking an interesting stretch of shore near Buddon Ness in the 1970s was used by shooters as well as birdwatchers. This was not a new problem; Harvie-Brown (1906), albeit writing at second-hand, referred to the persecution of nesting birds here, and advocated similar measures to those applied at Tentsmuir - protected since 1897 by an Order under the Wild Bird Protection Acts (Marchant and Watkins, 1897), and also partly subject to access restrictions by the landowner.

Fortunately, increasing use by the army has brought about such an outcome. Even Boase (1962) noted that military training restricted access for much of the summer, and substantial investment in new facilities means that the area is intensively used year-round. There are now relatively few days of the year when unrestricted public access is possible, and barriers to vehicle access mean that even during these periods, only a few walkers, horse-riders or cyclists penetrate far into the Links. However, the attractiveness of the area for breeding birds is affected by other factors besides disturbance, and the effects of the removal of sheep grazing will be interesting to monitor. While some ground-nesters such as terns favour very short vegetation or even bare ground, most species prefer longer vegetation; but if it becomes too rank, it is less suitable for many species. At Aberlady Bay Local Nature Reserve in East Lothian, sheep grazing has recently been reintroduced after a 50-year absence to restore the former value of the grassland to breeding waders (Thomson, 2004).

18. Mammals

The largest resident land mammal is the Roe Deer *Capreolus capreolus*, up to 36 of which live in the wooded areas[60]; they cross the railway, and have been known to swim across the Firth of Tay (Sayers, 1991). The place-name Monifieth has been translated as 'Moss, or Muir, of the Deer' (although other meanings are at least equally probable; Malcolm, 1910), and sub-fossil antlers belonging to Red Deer *Cervus elaphus* have been found in the peat beneath the turf of the golf course. A fine

pair attached to a skull was found in the mid-19th century (Ritchie, 1920; Carmichael and Ritchie, 1921; Whitehead, 1964); however, prehistoric Red Deer antlers have been found widely in excavations in Tayside, including in central Dundee, so they do not necessarily indicate the species' recent distribution. A more recent report of Red Deer tracks found at Barry Buddon (in Woolven, 1987) seems unlikely, though not impossible, as single stags can wander widely from the Highlands.

The most obviously abundant mammal today is the Rabbit *Oryctolagus cuniculus*, which arrived in the 19th century. Don (1813) and Headrick (1813), writing when Rabbits were still rare in Angus, both suggested that rabbit warrens would be the best use for the sandy soil. Given the suitability of the land for the purpose, it is surprising that Rabbits had not been introduced much earlier. In any case, Don and Headrick were proved right; Warden (1881) described Buddon Ness as "a huge rabbit warren". In the 1980s, a rabbit-catcher worked for MoD (Woolven, 1987), seemingly with little effect, because a decade later MoD regularly hired a butcher "to cull as many rabbits as possible to cull the ever increasing population" (MacInnes, 1997). Efforts are still made to control Rabbits within the range beds and camp, primarily to avoid injuries to army personnel, and a rough shooting syndicate is licensed to cover the whole area. The tracks of Foxes *Vulpes vulpes*, Hedgehogs *Erinaceus europaeus* and Common Rats *Rattus norvegicus* can often be found on the beach, after their nocturnal scavenging expeditions along the strandline. A case of *Leptospirosis* (Weil's disease) in a soldier in the early 1980s was attributed to a rat infestation at Buddon Camp. Smaller predators include Stoats *Mustela erminea* and Weasels *Mustela nivalis*. Otters *Lutra lutra* have occasionally been recorded on the Buddon Burn and even at Buddon Ness (Cotton, 1977), while the American Mink *Mustela vison* is a less welcome recent arrival.

Very occasionally, Common Seals *Phoca vitulina* haul-out on the shore, probably if sick or injured. They are more often seen on the offshore sandbanks, and dead animals are sometimes washed up[61]. Much more rarely, Porpoises *Phocoena phocoena*, dolphins and small whales have been stranded (Henderson, 1976). In former days, cetaceans must have been more common; in 1154 Malcolm IV granted to the Abbey of Dunfermline the revenue from all whales captured in the Firths of Tay and Forth, while in 1613 James VI granted the "sole and onlie priviliege of quaile fishing for the space of nyneteen yeirrs" to two landowners farther up the Tay estuary, Sir George Hay of Netherliff (afterwards 1st Earl of Errol) and to Sir Thomas Murray of Glendoick (JD Boyd, in Gibson [1957]). Edward (1678b) considered that whale strandings occurred only "once in 20 years" along the whole Angus coast, but it is likely that he was referring only to larger cetaceans.

The earliest recorded whale stranding at Barry Buddon was in 1638, when one was stranded on Durham of Grange's fishing-ground. Durham considered the prize his

Figure 9

**False Killer Whales stranded at Buddon Ness, November 1935.
Illustration by Colin Gibson.**

own, but this was disputed by Patrick Maule (Admiral-Depute of the shore of Angus), and Durham and his two sons were indicted for "wrongous medling with ane quhall lyand upone the schore and cost of Angus and Sandis of Barrie, callit Buddon Sandis". At an Admiralty Court held "at the Budden Sandis, within the flood-mark of the sea", Durham lost the case - it was upheld that his charter only referred to salmon fishing, and did not include "great fishings, nor yet no uther claus that may comprehend ane quhall" (quoted by Gibson, original source untraced).

The most famous whale standing at Buddon was on 26 November 1935, when around 50-60 False Killer Whales *Pseudorca crassidens*, up to 6 m long, were reported by the lighthouse-keeper, trapped by the ebbing tide in a channel near Buddon Ness, about 0.8 km east of the lighthouse. After the next tide, 31 whales remained stranded there, while eight of those that escaped or were washed away simply beached again on the eastern shore. Three days after stranding, the last two survivors were shot by the SSPCA. A team of men and horses employed by Angus County Council dragged the carcasses into the dunes for burial - fortunately not before they were subject to scientific examination (Peacock, Comrie and Greenshields, 1936; Comrie, 1937). Other whales stranded at Ferryden and Montrose the same day, but the Buddon pod was by far the largest of a series of strandings along the east coast over a three-week period (Fraser, 1936). Just two years after burial, erosion of the dunes uncovered some of the bodies, which had to be reburied (Anon., 1968). In the 1960s and 1970s, erosion again exposed some of the bones, which still had the strong distinctive aroma of whale oil[62]. Wright (1981) reported that the dunes had eroded more than 10 m back from the burial place, so it is unlikely that any more will be uncovered.

19. Development Threats

But for the army, Barry Buddon would almost certainly have long ago been lost to housing, industry, holiday developments, forestry or - less likely - agriculture. Serious threats from industry only came with the discovery of North Sea oil, when any east-facing extensive level undeveloped coastal site was at risk. Before the existence of the oilfields was known, the ambitious Tay Valley Plan (Lyle and Payne, 1950), usually remarkable for grandiose schemes, failed to even mention Barry Buddon. It was protected from earlier industry by army ownership, and the fact that only in the 20th century did the technology develop that would make it possible to maintain the 10 m-deep channel just offshore by dredging. Even as late as 1970, the Tayside Development Study (Anon., 1970), after briefly considering the site's potential for an airport, thought that if Barry Links should become available for non-MoD uses, "priority should be given to the phased development of this strategic

coastal site for recreational purposes" - envisaged to include indoor sports as well as outdoor recreation.

By the time of the first Tayside Structure Plan (TRC, 1980) a planning policy was adopted that "The Buddon Peninsula be safeguarded for industrial development". Alarmingly for local residents, the policy even provided for a development-free safety buffer zone intended to protect nearby urban areas in the event of a major disaster. In fact, industrial development threatened even before publication of the Structure Plan.

There had been suggestions that Barry Buddon could be a suitable site for oil platform construction. These do not appear to have been serious proposals; in 1973, the government had identified the Lower Tay Estuary as a Preferred Development Zone, but more suitable sites than Barry Buddon were found elsewhere. A more likely threat was exposed in October 1978, when investigations by the Dundee *Courier* revealed that ICI had secretly been investigating Barry Buddon's potential for a huge petrochemical complex, with opportunities for associated industries to be based alongside. The *Courier* launched a campaign against the proposals; opinions were polarised, and Tayside can have seen few local issues which ever raised such heated debate. After one year the threat began to recede, and by October 1980 it became clear that, due to recession, changing markets and falling profits, ICI would not be taking its plans forward.

However, Barry Buddon remained a strategic industrial site. In February 1981, just a few months after the final abandonment of the ICI proposals, the *Courier* reported new proposals for another development: a Nissan Datsun car plant. The 320-ha development would have covered the north-western third of Barry Buddon. On this occasion site-specific plans had not been initiated by the company involved: Nissan had merely announced its interest in building a new plant in the UK, and Barry Buddon was just one of a number of sites that were considered potentially suitable. Despite a campaign by the *Courier*, this time supporting the proposals, Barry Buddon was not included on the shortlist of available Scottish sites put forward by the Scottish Economic Planning Department. The factory was eventually built in Sunderland.

The Second Tayside Structure Plan (TRC, 1988) showed more environmental awareness than the First (TRC, 1980); whereas the first plan had merely mentioned environmental impacts as a disadvantage of industrial development at Barry Buddon, the second plan referred to the need for care to avoid such impacts. By the time of the Third Tayside Structure Plan (Angus Council/ Dundee City Council/ Perth and Kinross Council, 1993), it was recognised that there was no longer a need to reserve such major strategic industrial sites, and the Buddon industry proposal was

deleted from the Plan. Barry Buddon had escaped the North Sea Boom unscathed, although it is still possible to trace the disturbed soil and vegetation over the route of the Frigg No. 3 underground gas pipeline which cut through Monifieth Links in 1980. The laying of this pipeline removed all vegetation from a strip of land over 100 m wide. Restoration of part of the area took the form of an experiment with 30 trial plots using various combinations of seeding and fertiliser application, sown in September 1981, and intended to inform future dune pipeline restoration projects elsewhere[63]; the major part of the area was sown with an annual ryegrass and left for native plants to colonise naturally (Band, 1983).

Another pipeline that crosses the northern part of the links is the Tay Wastewater System sewer from Dundee to Hatton Wastewater Treatment Plant, laid in 1999/2000, which runs broadly parallel to the road and skirts the southern edge of Carnoustie Golf Links; only part of the route crosses the SSSI, and reinstatement was required as a planning condition for the works, with the topsoil being stripped and set aside ahead of excavation. These precautions proved very effective within the SSSI, where the speedy and near-complete recovery of natural vegetation contrasts with the rutted and weed-infested state of some parts of the pipeline route outwith the designated site (SNH, 2005).

A one-off amphibious training exercise held in May/June 1966 probably had a major impact on the local ecology, when Barry Buddon hosted the largest air-strip-building exercise carried out in Britain: 320 Royal Engineers were landed from the assault ship HMS *Fearless*, along with 30 vehicles including bulldozers, cranes and excavators, and several hundred tonnes of stores. Within two weeks, a 3,000-foot airstrip had been built "on scrubland a mile from the shore". Fuel tanks were erected to hold aviation fuel piped from a tanker offshore, and an Armstrong Whitworth Argosy transport plane was flown in to prove the airstrip. It is likely that an already-level area was chosen for the exercise, but is a tribute to the powers of recovery of dune ecosystems that it is no longer possible to identify the site of this exercise.

There have been other threats associated with army training facilities, especially following an intensification of training activities in the 1980s and 1990s. In January 1987 there was controversy over plans to construct two houses on the links for training in urban warfare. The rebuilding and expansion of Buddon Camp in the late 1990s with larger, more permanent buildings and improved security and lighting certainly had an impact on the landscape, creating a more urban appearance, but the reconstruction was largely kept within the perimeter of the original camp, and outside the SSSI. Overall, the environmental impacts of military buildings on the Links have been localised and small-scale; the most far-reaching impact is likely to be from the coast protection works intended to prevent erosion of the firing ranges (see 'Erosion and Coastal Defence' above).

20. Research and Conservation

Previous studies

Military ownership and consequent access restrictions must have limited scope for research, resulting in many studies being carried out at Tentsmuir rather than Barry Buddon - there is far less information for Barry Buddon published in the scientific literature, or even in unpublished reports, than for Tentsmuir. Tentsmuir has been the subject of well over 100 research projects since 1954 (Booth, 1991; Cunningham, 2004; McLeod, 2005), and, like a number of other large dune systems, has had an entire volume devoted to it (Whittington, 1996a), while Barry Buddon has received relatively scant coverage even in general works on British sand dunes. One Victorian naturalist explicitly stated the reason, "...on the other side of the Tay there is a similar tract of ground - Tents Moor - which, being more convenient of access than Barry Links, has been visited by us much more frequently" (Fulton, 1890). Woolven (1987) stated that "natural history records for Barry Links did not begin until 1954, and are sparse until the 1970s". In fact, this is not correct[64], but her assertion does indicate both the relative dearth of information, and the fact that much of what had been recorded remains relatively obscure.

Woolven (1987) also commented that there had been short-term studies but strictly limited long-term monitoring and research - something that, with the possible exception of birds, remains largely true today. One benefit of the industrial development proposals in the early 1980s was the commissioning of surveys that provided geological data from borehole surveys (Paterson, 1981) together with further hydrographic information about tides and currents (for example Sarrikostis and McManus, 1987), supplementing the extensive data about the Firth collected by Dundee University's Tay Estuary Research Centre.

It is unfortunate that scientific studies of Barry Buddon began so late. Baseline data that would be important for any future monitoring of change is lacking. Inadequate knowledge of the flora and fauna could have resulted in early conservation efforts being misdirected - for example, Doody (1989) has highlighted how over-stabilisation may be as much a problem as erosion, and attempts to stabilise naturally dynamic dunes, such as those carried out at the Gaa Sand Hill as recently as the 1990s, may be contrary to the requirements of many specialised duneland invertebrates (Welch, 1989). The need to maintain dynamic components within sand dune systems has only been recognised relatively recently (Ritchie, 1991; Brooks and Agate, 2001). Despite this, due to a combination of army ownership bringing land use which is broadly compatible with conservation, the inclusion of almost the whole area within a single management unit, and its large size and relative intactness, Barry Buddon would seem to have retained a more functional natural ecology than at

the intensively researched and managed Tentsmuir Point NNR across the Tay, which now consists of only the seaward portion of what was once a much larger dune system (Crawford, 1996; Huxley, 1996).

Woolven (1987) provided species lists for a range of plant and animal groups, highlighting noteworthy species, and identified a large number of research projects desirable to build up a comprehensive understanding of Barry Buddon - only a few of which appear to have progressed. However, in recent years, annual records of a range of observations, in addition to birds, have been maintained by the army.

Marine studies

The physical environment of the estuary and Firth of Tay have been particularly well researched, and there have been a number of ecological studies of the Tentsmuir shore (see Bennett and McLeod, 1995 for review), but there has been much less study of the marine biology of the northern shore. Although the earliest marine biological records from the 'Sands of Barrie' date from Don (1813), until recently there had been just one survey extending to Monifieth Bay, having an easternmost sampling station near the mouth of the Buddon Burn (Jones, Herbert and McManus, 1990), and two surveys of the open coast at Carnoustie (Stephen, 1929; Jones, Herbert and Caudwell, 1993). This lack of marine biological study has recently been rectified by a comprehensive broad-scale habitat mapping exercise covering the whole Firth of Tay and Eden estuary (Bates *et al.*, 2004), undertaken primarily by remote sensing, ground-truthed by intertidal surveys which included sampling stations in Monifieth Bay and at Buddon Ness. This is the first study to have investigated the littoral biotopes present, finding the middle and lower shore east of the Buddon Burn to support a polychaete-dominated infauna (LGS.AP.P), with an amphipod/isopod-dominated infauna (LGS.AEur) at higher levels. Towards Buddon Ness, the wave-form runs more parallel to the shore, and the latter biotope becomes prevalent at all levels except the lower margin of the shore, where an impoverished amphipod/polychaete fauna occurs (LGS.AP). The most easily noticed of these polychaete worms is the Lugworm *Arenicola marina*, whose mounds are a prominent feature on level parts of the middle and lower shore.

Botanical studies

The first plant record from Barry Buddon dates from the early 18th century (Blair, 1722, quoted in Ingram and Noltie, 1981). More systematic records of the flora of Barry Buddon were collected in the early 19th century (Don, 1813), and especially by Gardiner (1848), who recorded vascular plants, bryophytes, lichens and fungi. Members of Dundee's Gleaners of Nature visited in August 1829, making some

botanical observations (Gardiner, 1829). Another visit was arranged for the autumn of 1832, but no description survives. Gardiner himself passed through the northern part of the links in June 1831, and explored the interior the following month, leaving brief descriptions and botanical notes of both occasions; in the latter, he mentions "two gentlemen from Edinburgh who botanised these sands" a few days earlier (Gardiner, 1831a, b). In the first half of the 19th century, Barry Buddon was not of mere local botanical fame. Even the great William Hooker (1830) noted the links as the sole site then known for a white-flowered variety of *Orchis latifolia*[65], quoting a record from the Forfar botanist Thomas Drummond.

However, the area seems to have been largely ignored by later Victorian naturalists - it is possible to give every known visit in a short list, something that would be near-impossible for Tentsmuir. A large party of botanical students from Edinburgh University under Professor J.H. Balfour made an excursion by steamer and special train in July 1875, and a summary of their more interesting discoveries was published (Anon., 1875).

The great Scottish naturalist Francis Buchanan White spent the summer of 1884 in Carnoustie, yet uncharacteristically made few natural history observations[66] - although he did lead a small party from the Perthshire Society for Natural Science to Buddon Ness two years later (Barclay, 1888). The Arbroath Horticultural and Natural History Association made a single visit to Barry Links in July 1884, jointly with the Dundee Naturalists' Society (Anon., 1930; DNS, 1884). Although the latter body made regular visits to Tentsmuir, until recently Barry Buddon seems to have featured in its excursion programme only at half-century intervals, in 1933 and 1991. However, some of its members did take part in surveys there in the 1980s.

In 1947, Rechinger (1950) carried out a brief taxonomic investigation of the willows growing on the Links, nearly 120 years after Gardiner (1831b) had noted that "many species of *Salix*" were present. The first attempt at a systematic botanical survey did not take place until the mid-1970s (Milne, 1976), and habitats were first mapped in the late 1970s (Ellwood, 1979). Further, more detailed vegetation surveys followed (Woolven, 1987; Dargie, 1995), while Dargie (2001) extended this coverage into the area of former links to the north of the railway, now largely farmland and golf courses.

The latest list of vascular plants is by Hogarth (2004). Duncan (1966) recorded many bryophytes from Barry Buddon, but it appears from her account that access to the area for survey was limited by army restrictions, and Chamberlain's (1979) visit on a single day covered only three areas (two of which were surveyed in detail). Woolven's (1987) coverage was also constrained by military restrictions.

Ornithological studies

In contrast to Tentsmuir, a regular haunt of birdwatchers (and collectors) since the earliest days of Scottish ornithology (Mearns and Mearns, 1998), the birds of Barry Buddon were relatively little-studied before the 1970s. H.R. Colman investigated bird migration at Buddon Ness between September 1922 and October 1925 (Boase, 1927); these studies were continued by Henry Boase, particularly after 1946 (Boase, 1962). Norman Atkinson compiled the first comprehensive list of birds, concentrating on the late 1960s and 1970s (Anon., 1979; Ellwood, 1981b). Today, birds are monitored by an annual MoD bird count, supported by the BTO Common Bird Census and work carried out by the Tay Ringing Group since the 1970s (McCurley, 1997, 2003). Ringing effort restarted in 2000 after a lapse of some years, and has focused on several locations, including the reedbeds near Buddon Camp and scrubland sites in the east of the Links, with a total of 956 birds of 37 species being ringed in the first five years (Arthur *et al.*, 2001, 2002, 2003, 2004; Ellis, 2005). Nestboxes have been erected to create breeding sites for various bird species, and several disused army buildings have been made secure to provide safe nesting-places for swallows. A total of 59 bird species have been recorded as breeding in recent years, with a further 21 wintering and 47 passage migrants (McCurley, 1997, 2003). Access restrictions have undoubtedly resulted in the area being less well-studied by birdwatchers than might otherwise be the case - despite occasional sightings of rare migrants, it is notable how few bird/wildlife sightings have been reported for Barry Buddon in the Angus Bird Reports and in the newsletters of local organisations such as the Scottish Ornithologists' Club Tayside Branch, compared to other areas of wildlife interest on the local coastline.

Entomological and other invertebrate studies

Other faunal observations began with Don (1813), who makes a few mentions of the fauna, mainly of strandline specimens, ending his account tantalisingly "I have seen a great number of minute shells, of different species, in moist places on the Sands of Barrie…but never had time sufficient to examine them". Even published short notes of discoveries at Barry Buddon are few, compared with other major sites - Carter (1921), in a rare exception describing beetles[67], thought it probable that the sandhills had never been collected over[68]. More in-depth studies of invertebrates began much later. Even as late as 1976/77, when the Institute of Terrestrial Ecology was commissioned by the Nature Conservancy Council to undertake a major comparative study of the invertebrate fauna of a large number of dune sites around the Scottish coast (Welch, 1989) - a survey prompted by the development of North Sea oil, with the need to ensure that onshore installations avoided sensitive areas - no sampling was carried out at Barry Buddon. Dundee Museum undertook entomological surveys in the late 1970s and early 1980s, including pitfall-trapping

and light-trapping, concentrating on the western section near Buddon Camp, which was part of the former Dundee District. White (1983) listed several noteworthy beetle species, noting that Barry Links supported many species with a southern distribution, a finding confirmed for other insect groups also (Woolven, 1987). By January 1995, 242 beetle species had been recorded, of which over one-third were of local or national importance; of the 127 spiders, the proportion considered notable was almost as high (SNH, 2005). Garside (2000) recorded a number of local and rare beetle species, and considered that the biodiversity of Barry Links remained high. The new permanent ponds created by the army in the northern part of the site mean that Barry Buddon is becoming known for dragonflies (Lawie, 1998), in addition to insects that might more typically be expected on a duneland site. Barry Buddon scores grade B under Invertebrate Site Register criteria, meaning that the area merits SSSI status on this basis alone.

21. Statutory Protection and Conservation Management

The army certainly brought changes to Barry Buddon, and training activities have caused some damage to the wildlife interest; more significantly, it has resulted in the site not being managed primarily for conservation, resulting in the habitat declines identified by Dargie (1998). However, MoD ownership kept Barry Buddon intact until strong conservation legislation arrived in the late 20th century. From the mid-1970s, the army adopted some recommendations in the first management plan (NCC, 1976) to limit damage to sensitive areas (Woolven, 1987). Barry Buddon remains one of the largest areas of largely unspoilt habitat in Tayside, and certainly the largest in the lowlands. Although most of Barry Buddon was notified as a Site of Special Scientific Interest (SSSI) in 1961, ten years were to pass before conservation bodies took a serious interest in the site. This interest was stimulated in 1971 by a government review of the MoD's countryside and coastal landholdings by the House of Commons Defence Lands Committee, chaired by Lord Nugent of Guildford. The Scottish Wildlife Trust's Angus and Dundee Branch, through its scientific sub-committee, made a submission to the Nugent Committee, stressing the importance of the links for nature conservation, and recommending that conservation should be given prominence over possible alternative land uses. In the event, the review did not seriously affect Barry Buddon; about 50 ha of MoD land in the north-eastern part of the site, not of particular importance to wildlife, was sold to Tayside Regional Council to enable expansion of the golfing facilities at Carnoustie - an area later developed as the Buddon Links Course. The main significance of this development was that coast protection measures very soon became necessary to protect the new golf course from coastal erosion - bringing forward the first step of an engineering scheme which would have major implications for the whole local coastline. A more positive outcome of the Nugent report was an official awareness of the conservation

value of the Defence Estate (Baker, 2001), paving the way for the first organised efforts to protect wildlife.

Active conservation efforts began in the mid-1970s under the sympathetic Camp Commandant, Major Stephen Ellwood, with the formation in 1975 of the Barry Buddon Conservation Committee, comprising representatives of the Ministry of Defence, the then Nature Conservancy Council, and the Scottish Wildlife Trust (Anon., 1977)[69]. An early action for the group was to complete the first management plan for the area (NCC, 1976), subsequently updated in 1983, and again by Woolven (1987) as a student dissertation project. The latest management plan covers the years 2005-2011 (SNH, 2005). An Environmental Management Scheme now informs all activities which take place on the MoD land, and this should ensure that they are compatible with the nature conservation interest. A Nature Open Day, a joint excursion for members of various wildlife groups including the Dundee Naturalists' Society, RSPB, Scottish Ornithologists' Club and Scottish Wildlife Trust, has been held annually in summer since 1989 (Young, 1990), and attracts visitors from as far away as Aberdeen and central Scotland (Anon., 2004a, 2005). As part of the Angus Coastal Path, a new footpath/ cycleway was built during 2005, running parallel to, and south of, the railway, on a 10-metre-wide strip of land sold to Angus Council by the MoD. The path gives permanent public access to at least the northern edge of Barry Buddon for the first time in over 110 years.

Barry Links was notified as a SSSI for its physiographical, botanical, ornithological and entomological importance (NCC, 1984); Woolven (1987) assesses the reasons for selection in detail. In 1995, it was submitted to the European Commission as one of the UK's first candidate Special Areas of Conservation (cSAC) on account of its suite of dune habitats, namely embryonic dunes, shifting dunes, dune grassland, dune heathland, and dune slacks; it was finally designated as a SAC in March 2005 (Hopkins and Radley, 2001; McLeod *et al.*, 2005). It is also a Geological Conservation Review (GCR) site for the geomorphological importance of its dunes (Hansom, 2003a). It remains one of the top ten largest sand dune systems in Britain, and is probably within the top five largest acidic examples (Woolven, 1987). Not all of Barry Buddon is within the designated areas, but the non-SSSI semi-natural habitat along the northern boundary contributes to the overall integrity of the site, and along with the neighbouring golf courses, provides a valuable buffer zone.

Barry Buddon is even more important when considered as an integral part of the larger Tay estuary system: the whole Firth of Tay and Eden Estuary is also a SAC, and a Special Protection Area (SPA) and Ramsar site for its international ornithological importance (Pritchard *et al.*, 1992; Smith and Shepherd, 1998; JNCC, 2005; Stroud *et al.*, 2001; McLeod *et al.*, 2005); the SPA/Ramsar site includes a small part of Barry Buddon itself. Studies of St Andrews Bay are being undertaken to assess whether it

also merits SPA status because of its importance for wintering wildfowl (Dean *et al.*, 2003, 2004). Across the Tay, Tentsmuir Point is a National Nature Reserve (NNR) and GCR and Nature Conservation Review (NCR) site, and the contiguous Eden Estuary is a Local Nature Reserve (Barne *et al.*, 1997; Buck, 1993; Hansom, 2003b; Ratcliffe, 1977). The national conservation importance of the Tay estuary system was recognised at an early stage in the identification of Britain's key wildlife sites (SNPC and WLCC, 1949; Ratcliffe, 1977). Inexplicably, Barry Buddon itself was not included in either of those seminal reviews, so its exceptional value as a component of the Tay system, and in its own right, was only acknowledged after the 1992 EC Habitats Directive required the UK to designate a network of sites of European importance as SACs. Woolven (1987) is almost certainly correct in asserting that the relatively late recognition of Barry Buddon's significance was largely the result of the limited scope for research due to access restrictions - although other sites on MoD land subject to similar restrictions had been included in the reviews mentioned above.

The protection afforded by European designations mean that the future of Barry Buddon and neighbouring designated sites is more secure than ever. Furthermore, the legal requirement imposed by European Directives to ensure that the qualifying features on SACs and SPAs are maintained in favourable conservation status means that designation is not a matter of mere labelling, but will ensure that all necessary measures are implemented to ensure that the interests are conserved for future generations. The current management plan (SNH, 2005) is a key document in ensuring that outcome.

22. Information for Visitors

Visiting: Pedestrians can approach Barry Buddon from Monifieth, Barry or Carnoustie, but as a busy army training-ground, public access other than along the line of the Angus Coastal Path is possible only on a relatively few days of the year. There is no firing on the majority of evenings and public holidays, and an annual Nature/Open day is held every summer - the next one is planned for 13 August 2006. Live firing diaries are posted in the local library and in the *Arbroath Herald*, but training requirements can change at short notice. Anyone thinking of travelling some distance to visit Barry Buddon would be best advised to check with MoD Range Control (0131 - 310 3426/ 310 3450) for accurate daily information. The MoD warning signs and 'red flag' restrictions must be obeyed at all times.

23. Appendix: Species Lists

The lists of vertebrates given here include information additional to previous lists. Woolven (1987) gives lists for a wider range of species.

Mammals

Hedgehog *Erinaceus europaeus*; Mole *Talpa europaea*; Common Shrew *Sorex araneus*; Pygmy Shrew *Sorex minutus*; Common Pipistrelle *Pipistrellus pipistrellus* (unconfirmed; a sighting of a small bat in flight by Woolven (1987) and other sightings during moth-trapping sessions near Buddon Camp were thought to be probably this species); Brown Long-Eared Bat *Plecotus auritus*; Rabbit *Oryctolagus cuniculus*; Brown Hare *Lepus europaeus*; Red Squirrel *Sciurus vulgaris*; Bank Vole *Clethrionomys glareolus*; Field Vole *Microtis agrestis*; Water Vole *Arvicola terrestris*; Wood Mouse *Apodemus sylvaticus*; Common Rat *Rattus norvegicus*; Minke Whale *Balaenoptera acutorostrata* (Stranded, Buddon 13.03.1926; Carnoustie 20.09.1939); Northern Bottlenose Whale *Hyperoodon ampullatus* (Stranded, Carnoustie 07.08.1916); Common Porpoise *Phocoena phocoena* (Stranded, Carnoustie 27.07.1948; also at least one more recent stranding near Monifieth unrecorded by Henderson (1976)); Common Dolphin *Delphinus delphis* (Stranded, Monifieth 17.02.1937); White-Beaked Dolphin *Lagenorhynchus albirostris* (Stranded, Carnoustie 1922); False Killer Whale *Pseudorca crassidens* (Stranded, Buddon 26.11.1935); Killer Whale *Orcinus orca* (Stranded, Buddon 16.04.1941); Long-Finned Pilot Whale *Globicephala melas* (Stranded, Carnoustie 29.05.1944); Fox *Vulpes vulpes*; Stoat *Mustela erminea*; Weasel *Mustela nivalis*; Polecat-Ferret *Mustela furo*; American Mink *Mustela vison*; Otter *Lutra lutra* (sighting near Buddon Ness - C. Gibson; Cotton, 1977); Common Seal *Phoca vitulina*; Grey Seal *Halichoerus grypus* (Stranded); Red Deer *Cervus elaphus* (subfossil; recent tracks reported in Woolven, 1987); Roe Deer *Capreolus capreolus*.

The local area has not escaped claimed sightings of the 'Angus Big Cat', of which there have been over 70 reports throughout the county between 1976 and 2003. The closest of several nearby reports was of a "large black cat-like creature" seen on Buddon Golf Links in October 1998 (SBCT, n.d.).

Breeding birds (including former breeders)

Based primarily on McCurley (1997), supplemented by Ellwood (1981b), and other sources. Woolven (1987) lists the same species as Ellwood (1981b), but explains that her list was based on a 1976 BTO site register form, with later additions. For species not listed in McCurley (1997), source or additional details are provided.

Grey Heron *Ardea cinerea*; Mute Swan *Cygnus olor*; Ruddy Shelduck *Tadorna ferruginea* (? 1870s/80s - Drummond Hay, 1887); Common Shelduck *Tadorna tadorna*; Common Teal *Anas crecca* (Ellwood, 1981a,b); Mallard *Anas platyrhychos*; Northern Shoveler *Anas clypeata* (Ellwood, 1981a,b); Tufted Duck *Aythya fuligula*; Common Eider *Somateria mollissima*; Common Buzzard *Buteo buteo* (? - pair in residence, April 2004 - CRM); Eurasian Sparrowhawk *Accipiter nisus*; Common Kestrel *Falco tinnunculus*; Merlin *Falco columbarius* (?probably breeding - Ellwood, 1981b); Grey Partridge *Perdix perdix*; Common Pheasant *Phasianus colchicus*; Water Rail *Rallus aquaticus*; Common Moorhen *Gallinula chloropus*; Common Coot *Fulica atra*; Eurasian Oystercatcher *Haematopus ostralegus*; Ringed Plover *Charadrius hiaticula* (Ellwood, 1981b); Northern Lapwing *Vanellus vanellus*; Common Snipe *Gallinago gallinago*; Eurasian Woodcock *Scolopax rusticola* (Ellwood, 1981b); Eurasian Curlew *Numenius arquata*; Common Redshank *Tringa totanus* (Ellwood, 1981b); Long-Tailed Skua *Stercorarius longicaudus* (attempted 1980 - C. Gibson); Black-Headed Gull *Larus ridibundus* (Ellwood, 1981b); Sandwich Tern *Sterna sandvicensis*; Roseate Tern *Sterna dougallii* (Ellwood, 1981b; listed as former breeder by Woolven, 1987); Common Tern *Sterna hirundo* (Ellwood, 1981b); Arctic Tern *Sterna paradisaea* (Ellwood, 1981b); Little Tern *Sterna albifrons* (Ellwood, 1981b); Black Tern *Chlidonias niger* (unconfirmed breeder: "possibly the Sands of Barrie" (Marples and Marples, 1934)); Feral Pigeon *Columba livia* (Ellwood, 1981b); Stock Pigeon *Columba oenas*; Common Wood Pigeon *Columba palumbus*; Eurasian Collared Dove *Streptopelia decaocto*; Common Cuckoo *Cuculus canorus* (Ellwood, 1981b); Tawny Owl *Strix aluco*; Long-Eared Owl *Asio otus*; Short-Eared Owl *Asio flammeus* (Ellwood, 1981b); Green Woodpecker *Picus viridus*; Great Spotted Woodpecker *Dendrocopus major*; Sky Lark *Alauda arvensis*; Barn Swallow *Hirundo rustica*; Sand Martin *Riparia riparia* (Ellwood, 1981b); Meadow Pipit *Anthus pratensis*; Rock Pipit *Anthus petrosus*; Pied Wagtail *Motacilla alba*; Winter Wren *Troglodytes troglodytes*; Hedge Accentor *Prunella modularis*; European Robin *Erithacus rubecula*; Stonechat *Saxicola torquata*; Northern Wheatear *Oenanthe oenanthe* (Ellwood, 1981b); Common Blackbird *Turdus merula*; Song Thrush *Turdus philomelos*; Mistle Thrush *Turdus viscivorus* (Ellwood, 1981b); Sedge Warbler *Acrocephalus schoenobaenus*; Common Whitethroat *Sylvia communis*; Willow Warbler *Phylloscopus trochilus*; Goldcrest *Regulus regulus*; Long-Tailed Tit *Aegithalos caudatus*; Coal Tit *Parus ater*; Blue Tit *Parus caeruleus*; Great Tit *Parus major*; Eurasian Treecreeper *Certhia familiaris*; Eurasian Jackdaw *Corvus monedula*; Rook *Corvus frugilegus*; Carrion Crow *Corvus corone*; Common Starling *Sturnus vulgaris*; House Sparrow *Passer domesticus*; Eurasian Tree Sparrow *Passer montanus* (Ellwood, 1981b); Chaffinch *Fringilla coelebs*; European Greenfinch *Carduelis chloris*; European Goldfinch *Carduelis carduelis*; Common Linnet *Carduelis cannabina*; Common Redpoll *Carduelis flammea* (Ellwood, 1981b); Common Bullfinch *Pyrrhula pyrrhula* (Ellwood, 1981b); Yellowhammer *Emberiza citrinella*; Reed Bunting *Emberiza schoeniculus*; Corn Bunting *Miliaria calandra* (Ellwood, 1981b).

Amphibians and Reptiles

Common Frog *Rana temporaria*; Common Toad *Bufo bufo*; Smooth Newt *Triturus vulgaris*; Palmate Newt *Triturus helveticus*.

Common Lizard *Lacerta vivipara* (the only known coastal site in Angus (Brinklow (1997) - which Woolven (1987) attributes to a single sighting, late 1970s, although Ritchie and Sage (1975) earlier refer to the species being recorded from duneland in the county); Adder *Vipera berus* (an unlikely though not impossible record, from Sayers (1991) and Woolven (1997) - the only reported site in Angus south of the Highland Line). A Leatherback Turtle *Dermochelys coriacea* was stranded dead nearby on Monifieth Sands in 1957 (Brongersma, in Langton *et al.*, 1996).

24. Notes to Main Text

1. For example: Culbin (Ross 1992); Sands of Forvie (North, 1991); Sefton (Atkinson & Houston, 1993; Smith, 1999); Tentsmuir (Whittington, 1996)

2. Although the name is usually applied to coastal lowlands, there is an inland Boddam in upper Glenesk, Angus - a level area at the confluence of two burns in Lochlee (Dorward, 2001).

3. Low (1944) calls these boulders the 'Bartig Rocks', but they seem to have been known as Black Rocks in the 1840s, when a vessel struck them.

4. Although often attributed to the 13th century Thomas the Rhymer, this appears to be just one of many local verses from around the country that claim his authorship, but which are not contained in the earliest surviving manuscripts of his writings (Thomas of Erceldoune, 1875).

5. Barry was anciently known as Fethmoref, Fethmure, Fetmoreth or Fothmuref, corrupted into Fettermore, interpreted as meaning 'well-wooded'. The only prominent 'brae' in the parish is the raised beach terrace mentioned above.

6. A layer of peat which may be comparable underlies the western part of Tentsmuir across the Tay, and dates from around 5500 years BP (Coles 1971; McManus, 1999b).

7. Similar historical inundations by sand have been reported widely around the British Isles and elsewhere in north-west Europe, at various dates between the 12th and 18th centuries. While the influx of sand has been attributed to extreme climatic events, overgrazing or over-cultivation have also been proposed as at least contributory factors (Ritchie, 1992).

8. The links covered a larger area in 1813, extending to the north of the present railway, but a larger extent was also under cultivation, so a crude guess can be made that the available grazing land at that time was not substantially different from today. Whether all the available land was capable of supporting this level of pasturage is another matter; if parts were unvegetated, the animals would be concentrated into a smaller area. It should also be remembered that the sheep breeds kept were probably smaller than modern sheep, perhaps small even by the standards of sheep of the time; Sim (1791-99) described "small Fife sheep, weighing 32 pounds" [14.5 kg]...of "a pretty durable constitution" being best adapted to the soil of Barry Parish.

9. "Considering that many Lands, Meadowes and Pasturages lying on the sea coasts have been ruined and overspread in many places in this kingdom by Sand driven from adjacent Sand Hills...His Majesty does strictly prohibit and discharge the pulling of Bent, Broom or Juniper off Sand Hills for hereafter."

10. By contrast, Tentsmuir, less exposed to prevailing westerly winds, exhibits a succession of parallel dune ridges behind the coast, a form much less influenced by wind regime.

11. Ainslie's (1794) map of Angus shows two neighbouring steadings with, confusingly, this same name - but no loch.

12. In recent times, only part of Tentsmuir's dunes was in such a mobile condition, and only for a brief period, after a severe fire was followed by a very severe gale in the 1870s (the same gale that destroyed the Tay Bridge) - by which time most of Tentsmuir's open water had been drained (Crawford, 1996). A much earlier period of wind erosion at Tentsmuir resulting from excessive burning during the Dark Ages seems to have been ended by an influx of organic-rich soil blown from adjacent arable land, encouraging the growth of grasses (Whittington & McManus, 1998).

13. Although no examples are known on the north shore of the Tay, 'submerged forests' were recognised at an early date on the Fife coast in the Tay estuary and the Firth of Forth (Fleming, 1822, 1830), so this story may possibly have some basis in fact.

14. The authorship and dating of the earliest maps and charts of the area is uncertain. Marr's role in the early charting of the Firth of Tay is reviewed by Laing (2002).

15. Land-claim at Monifieth will have contributed to the gain, but this cannot have accounted for more than a small part of the total.

16. Geikie's (1887) unexplained reference to a finding in 1816 merits further investigation. If the 'spot' that he alludes to was the remains of the earliest outer light, and he merely gave a premature date of construction, the rate of coastal retreat would be even faster than he supposed. However, the first lighthouse was a wooden structure reportedly in poor condition by 1711, and it seems unlikely that identifiable remains would survive underwater, still in their original location, to mark the spot a century later.

17. A well located some distance south of the high lighthouse seems too far from the present buildings for convenience, and might indicate the site of an earlier lighthouse-keeper's house.

18. As a result of this dumping, Monifieth's seafront is classed as contaminated land - which fortuitously, in 2003, enabled capital funding for coast protection works to be made available from the Scottish Executive.

19. Some of the most mature bushes are found near the Barry ranges in the north-east corner of Barry Buddon, a considerable distance from the extensive stands at Tentsmuir, giving credence to the deliberate introduction theory. Other established stands are present on the eastern dunes and at Monifieth Links, stretches of coast which have been perceived to be in particular need of stabilisation. Woolven (1987) says "sea buckthorn was introduced to the west of the site approximately 40 years ago, and to the east probably also around this date".

20. Woolven (1987) did not suggest how sea-buckthorn should be eradicated, and recognised that a reservoir of plants would remain in the Restricted Zone, an area of around 70 ha where access is unsafe due to unexploded munitions. At some dune sites elsewhere, mechanical flailing followed by chemical treatment has proved effective at eradicating extensive established stands of sea-buckthorn.

21. It is well-known that marram does not thrive in such circumstances (Huiskes, 1979), leading to what is sometimes erroneously called 'die-back disease'; studies in the Netherlands have shown that marram requires fresh sand to escape build-up of unfavourable soil biota (Putten & Peters, 1995).

22. A fine Pictish cross-stone which is said, improbably, to be Camus' memorial stands at Panmure, although it has been moved a few metres from its original site.

23. At that time called Barre or Barri.

24. In fact, the commission or tack of the Bailiary of Barry had first been granted to Thomas Maule in 1511 (Warden, 1881) - "memory of man" in the 16th century was less than 90 years.

25. Unfortunately, there are no obvious matches to these initials amongst the names recorded in the County Valuation Rolls or censuses for the period, and the practice of so inscribing a tenanted cottage is unusual. The 1891 census records that Cowbyres was occupied by a family headed by Ann Donald, a 70-year old widowed grandmother and farmer. At the time of the 1881 census, before its rebuilding, the occupier was William Irvine, a gamekeeper.

26. Because of the flammability of dry turf, it was essential to keep fire away from the walls.

27. The overgrown foundations of the stone buildings of one of these farms remain, while its beech hedges are now mature trees.

28. It must be remembered that for the majority of the inhabitants, most daylight hours would be spent outdoors, and a house was simply a shelter for the night.

29. John McPhail was a game and poultry dealer of Union Street, Dundee.

30. Unlike the Buddon ice-house, which would seem to have been built by Hunter as landowner, the surviving Tentsmuir ice-house - which was not the first serving the area - was built by the tacksman Alexander Speedie, who had rented extensive fishings in north Fife, purchasing the rights at Tentsmuir and Earlshall outright in 1869 (Robertson, 1998).

31. In fact, 9.2 ins. muzzle-loaders were supplied instead of the 7 ins. breech-loaders.

32. Strangely, none of Barry Buddon's coastal defences are recorded on the Defence of Britain Database (Council for British Archaeology, 2002), although they are described by Guy (2000).

33. Although undamaged solid ordnance was collected for reuse, evidence of these activities may be provided by cannonballs which have occasionally been found buried in the Links (although some of these may date from the skirmish in 1651), while numerous rifle- or musketballs or grapeshot can be found around the Gaa Sand Hill. Davidson (1937) noted that lead fragments originating from spent ammunition even formed a component of the beach sand. The links are also littered with more recent spent bullets and shrapnel, while unexploded munitions pose a potential hazard. The fuses of early explosive shells were notoriously unreliable, and during the years between the commencement of regular artillery practice on the 'long' range and the start of World War I, there were nearly 50 fatalities, mainly amongst local men attempting to salvage shells for their scrap value.

34. Most army horses were however not reared locally, but were imported from Ireland, and

many were kept only for the summer camps, surplus animals being auctioned at the end of the season. This dispersal seems to have facilitated the spread of equine grass sickness, a serious (usually fatal) disease first suspected in Angus in the late 19th century, with one of the earliest recognised major outbreaks occurring amongst army horses at Barry Camp in 1905 (Miller, 1999).

35. Horses were not the only animals worked - in the early 1900s Barry Buddon hosted pioneering (albeit unofficial) exercises for training army messenger dogs and ambulance dogs (Richardson, n.d.).

36. The minute books, accounts and annual reports of Barry Soldiers' Home are held in the National Archives of Scotland, ref. GD1/535/1-6.

37. By 1998 over 70% of the British army was stationed in the UK, against just 49% in 1990 (Baker, 2001).

38. The cups are preserved in Dundee Museum.

39. The first officially authorised light in Scotland was a beacon on the Isle of May, established by Royal Letter-Patent as late as 1636 (Munro, 1979).

40. Although Gibson attributes this act of generosity in 1687 to George Maule, 3rd Earl of Panmure, the 3rd Earl died in 1686 and his brother James Maule (1658 - 1723) inherited the title and estates.

41. As the full accounts of the Seamans' Fraternity from this period survive (Dundee City Archives GD/HU/SF/3/4), a detailed study would reveal not only the full cost but also information about the construction of the lighthouses. There appears to be no record of any outlay by the Fraternity in connection with Buddon prior to 1687, further evidence that there was no earlier light.

42. Although there were no harbours between Dundee and Arbroath at that time, Sim (1791-99) describes how small vessels could safely be beached on the sands to discharge a cargo of coal, most likely brought from the Fife coalfields.

43. At first whale oil would have been burned, but by the mid-19th century consideration was being given to using vegetable (colza) oil. The accounts from the period 1846-90 show regular payments for the carriage of oil casks to Buddon Ness.

44. By 1845 the Seamans' Fraternity had already provided a series of unlit buoys to mark the channel, and thought that there was no better-marked river in Britain (Anon., n.d.).

45. Such research might permit more accurate inferences to be made regarding the rate of coastal change, not only between 1753 and 1867, but using Blackadder's (1826) map, also between 1687 and 1753, subject to caveats over possible sources of error such as those identified by Carr (1962).

46. A situation which, in an isolated location, had potential for problems, alluded to in a memoir by Robert Stevenson (1772 - 1850): 'In walking along with Mr._, I explain to him that I should be under the necessity of looking more closely into the business here from his conduct at Buddonness, which had given an instance of weakness in the Moral

principle which had staggered my opinion of him. His answer was, "That will be with regard to the lass?" I told him I was to enter no farther with him upon the subject' (Stevenson, 1912, Chapter II-II).

47. The present-day successor to Dundee Port Authority, and owner of the lighthouses, is Forth Ports PLC.

48. Thus ended a very long family connection, for although Liness had served elsewhere earlier in his career (Gibson, 03.01.1975), his father had been lighthouse keeper at Buddon before him (R.T. McLeod, pers. comm.). In contrast, the surviving journals for the Low Lighthouse show a steady turnover in postings, with five keepers (excluding assistant/relief keepers) between 1903 and 1912.

    Unfortunately, the records from individual lighthouses deposited in the National Archives of Scotland do not include the Buddon Lights, although relevant records are contained in more general files and the Dalhousie Muniments in NAS GD45/16/1432 (NAS n.d.; SRO n.d.). A short article by 'Craigie' (probably Colin Gibson) published in the *Courier*, 05.12.1989, mentions that the old lighthouse logbooks were at one time stored in the old tower adjoining the keeper's house; their present whereabouts is not known. The journals for Buddon Low Lighthouse 1903 - 1920 (excluding 1911/12) are held in Dundee City Archives (Ref. GD/X166), and other relevant records from the Seaman's Fraternity and Port of Dundee are also held there as part of the Dundee Harbour Archives (F9 series).

49. Drumlan, Drum Law, Drumlay or Drumley were old names for Abertay Sands; James Grant's (1855) historical novel *The Yellow Frigate* gives yet another variant - Drummilaw.

50. The reinforced concrete foundations of a later military structure stand close to its approximate site.

51. Despite the failure of his Buddon village, Hunter did succeed in establishing a small new planned settlement elsewhere on his estate, Hunter's Town, a suburban satellite village of Carnoustie (Lockhart, 1982, 1986).

52. The apple boat was a vessel wrecked around 1909 (Anon., 1969)

53. The Tay River Purification Board did not gain full responsibility for tidal waters until December 1971.

54. *Phragmites* has become increasingly dominant around the mouth of the Buddon Burn recently, perhaps in response to the lengthening of the sand-spit, and limited clearance of reed is an option to maintain habitat diversity.

55. Watling & Rotheroe's (1989) published account does not list fungi species found at Barry Buddon, but a list from a 1980 site visit is given in Woolven (1987).

56. Although *Empetrum* tolerates a wide range of soils (Bell & Tallis, 1958).

57. While it is natural for the calcium carbonate content of calcareous sands to gradually decrease over time, Duncan (1966) did not suggest any cause of further acidification at Barry Buddon. Barry Buddon lies downwind of Dundee which could have been a

significant source of low-altitude pollution at that time. As a naturally acid dune system, the soil's capability for buffering against any effects of acid pollution would be limited. However, it is likely that the process of drying-out itself affected soil chemistry including pH. Current levels of both sulphur dioxide and acid deposition in the area are well below the critical loads for sand dunes (APIS, 2004), although the effects of historic exposure could still be apparent.

58. Woolven's (1987) interpretation is that Big Wood is a later, and entirely separate, entity from the original 1770s plantation, of which Fir Park was a part, and which she considers was felled pre-1826. However, it seems unlikely that a thriving plantation would be felled at barely 50 years old, only to be replaced almost immediately by another on an adjacent site.

59. The Long-tailed Skua nesting attempt, not far from the lighthouse, took place amid such secrecy to protect the birds from egg-collectors that even today published details are conflicting. In several articles afterwards, Gibson describes a pair being present (and furthermore being photographed by the Camp Commandant, Major Stephen Ellwood), and egg-laying as taking place, but says that the nest failed due to predation by crows; a single bird is said to have returned the following summer. Thom (1986) (without giving the location) says that a single adult summered in 1980, and was later seen accompanied by a juvenile, suggesting that fledging was successful though not proved. The case is all the more remarkable because the few other summering (but non-breeding) Long-tailed Skuas recorded in the British Isles have typically been associated with Arctic Skua *Stercorarius parasiticus* colonies in the far north of Scotland.

60. Estimates of the Roe Deer population have increased over time, it is not clear whether due to actual population growth or more accurate estimating. Woolven (1987) estimated the population at about 15; Sayers (1991) at up to 25; and A. Gurmin (pers. comm. 2004) at 36, of which about 24 are resident. Despite efforts by the MoD Deer Management Group to maintain the population at that level by culling, there is a perception that recently the population has increased substantially, perhaps reflecting the extent and age of woodland in the area.

61. Edward (1678b) gives a hint that Grey Seals *Halichoerus grypus* formerly pupped here, though they have long since abandoned all their former mainland breeding grounds on the east coast of Scotland: "There are sea-calves in the frith of Tay perfectly white".

62. Some of these bones and teeth are preserved in Dundee Museum.

63. Despite this intention, results of the experiment seem never to have been published in any peer-reviewed journal, leaving key studies of the topic to be undertaken in Aberdeenshire (Ritchie & Gimingham, 1989). However, the fenced area later provided a convenient, if perhaps untypical, control site for MacInnes' (1997) study of the effects of rabbit-grazing.

64. The earliest botanical record from Buddon Ness had been published 236 years earlier (Blair, 1722), though almost certainly based on a visit undertaken before 1715; the Links were well-known to 19th century botanists, and Woolven (1987) herself cites Rechinger's (1950) study undertaken in 1947. It is not clear to what Woolven's '1954' reference refers.

65. Narrow-leaved Marsh-Orchid [now *Dactylorhiza traunsteineri*] is a species not known in eastern Scotland. While the record must refer to one of the marsh orchid species, there seems to have been little consistency by botanists in the use of the name *Orchis latifolia* during the 19th century.

66. Taylor (1986) speculates that White's stay may have been in the nature of a family holiday, but even so it is remarkable that the renowned willow expert seems not to have examined the rare *Salix* hybrids which occur on the links (Rechinger, 1950); we can be certain that, if White had found these, his observations would have been published.

67. Carter lived for some years in Monifieth, and collected on the links. Carter's main entomological interest was in Diptera, and one of his specimens from 'Monifieth' was later used as a syntype from which the hoverfly species *Syrphus* (=*Eupeodes*) *latilunulatus* was described (Collin, 1931); however, this species is not restricted to coastal habitats, and Carter published several notes in *The Scottish Naturalist* on the insects of his own garden, so there is no evidence that the specimen came from the links.

68. An incorrect assumption; a few noteworthy insects had been recorded by Gardiner (1848): the beetles *Carabus nitens* and *Phyllopertha frischii* [a synonym not recognised, but unlikely to be the only *Phyllopertha* species native to the UK, *P. horticola*, which is not recorded from Scotland], and the Dark Green Fritillary *Argynnis aglaia*. Even earlier, Gardiner (1831b) mentions collecting butterflies on the links, and describes the spider *Araneus diadematus* capturing a Small Tortoiseshell *Aglais urticae*.

69. These arrangements, and similar ones at many of MoD's other sites in Scotland, were put on a more formal footing in April 1994 when NCC's successor body, Scottish Natural Heritage, signed a Declaration of Intent to forge closer links with MoD (Magnusson, 1993).

25. References and Bibliography

This bibliography lists all references cited, together with other information sources specific to Barry Buddon and a small number of key references relevant to the wider local coastline and natural features of the area, based on a fairly comprehensive literature search including all issues of the MoD's *Sanctuary* conservation magazine. Modern technology has allowed this exercise to be much more complete than could have been possible only a few years ago. Published nationwide survey reports, isolated bird/wildlife sighting reports or very short articles are not listed unless cited. A location and catalogue number is given for unpublished archival material, where available. Despite efforts to have sight of as many items as possible, a few are known only from incomplete citations or extracts, but are included here for the sake of completeness. Supplementary or inferred information is given in square brackets [].

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26. Notes to References and Bibliography

1. p.477: "...specimens of *Festuca arenaria,* so named by Mr Gorrie, brought from the Sands of Barry, by Dr Knapp, ...were shown by Mr Campbell to be identical with a hairy var. of *Festuca rubra* from North Queensferry." The presence of *F. arenaria* at Barry Buddon has however been confirmed in recent years.

2. 3rd edition combines elements of the 1st (1872) and 2nd (1892) editions in facsimile. The previous editions have been cited where material is readily attributable.

3. Includes analysis of data for Barry Links collected 1996-1998.

4. These weekly popular newspaper articles appeared from 1954 until the Monifieth-based author's death in 1998, after which selected ones continued to be reprinted. Some early examples were collected in a series of booklets published by Dundee Museum between 1956 and 1959: *Spring on Tayside*, p.36; *Summer on Tayside*, p.22; *Autumn on Tayside*, p.15; *Winter on Tayside*, p.33, p.38; with a companion volume *Animals of Tayside* [1957], p.28. Most unattributed statements in the present paper refer to these articles.

5. Shaw, Hewett and Pizzey is a complex report to reference. The main report was issued in 1983, but it has seven separate appendices (some by different authors) issued at various dates between 1979 and 1985, some of which themselves contain appendices (!). Appendix 7 to the main report, 'Lichen flora of Scottish coastal sites', is dated 1979.

6. Referenced by Craven (1975) as King's and Lord Treasurer's Remembrancer (1891)

7. The Scottish Coastal Survey is a complex report to reference. The main report (Shaw, Hewett and Pizzey, 1983) has seven separate appendices by various authors issued at various dates between 1978 and 1985, some of which themselves contain appendices (!). A full list of parts is: Shaw, Hewett and Pizzey (1983) Main report; Shaw, Hewett and Pizzey (1983) Appendix 1. Annex to main report. Key to vegetation types; Institute of Terrestrial Ecology (1979) Appendix 2. Handbook of field methods; Institute of Terrestrial Ecology (1978) Appendix 3. Vascular plant distribution maps; Field, E.M. and Shaw, M.W. (1985) Appendix 4. Bryophyte distribution maps; Institute of Terrestrial Ecology (1978) Appendix 5. Lichen distribution maps; Field, E.M., Shaw, M.W. and Hewett, D.G. (1985) Appendix 6. Bryophytes in the Scottish Coastal Survey; Institute of Terrestrial Ecology (1979) Appendix 7. Lichen flora of Scottish coastal sites; Ranwell, D.S. (1980) Supplement to Appendix 7. 'Lichen flora of Scottish coastal sites'

8. Article refers to "a former...account in these columns" describing the topography of the site. This previous article was published in *The Scotsman* on 7 August 1894 (p.7), but has not been seen by the present author.

9. Comprehensive index compiled by Russell, G. (1961), Arbroath Public Library.

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The computer-generated location map in Figure 1 was produced with the assistance of Kate Turner.

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